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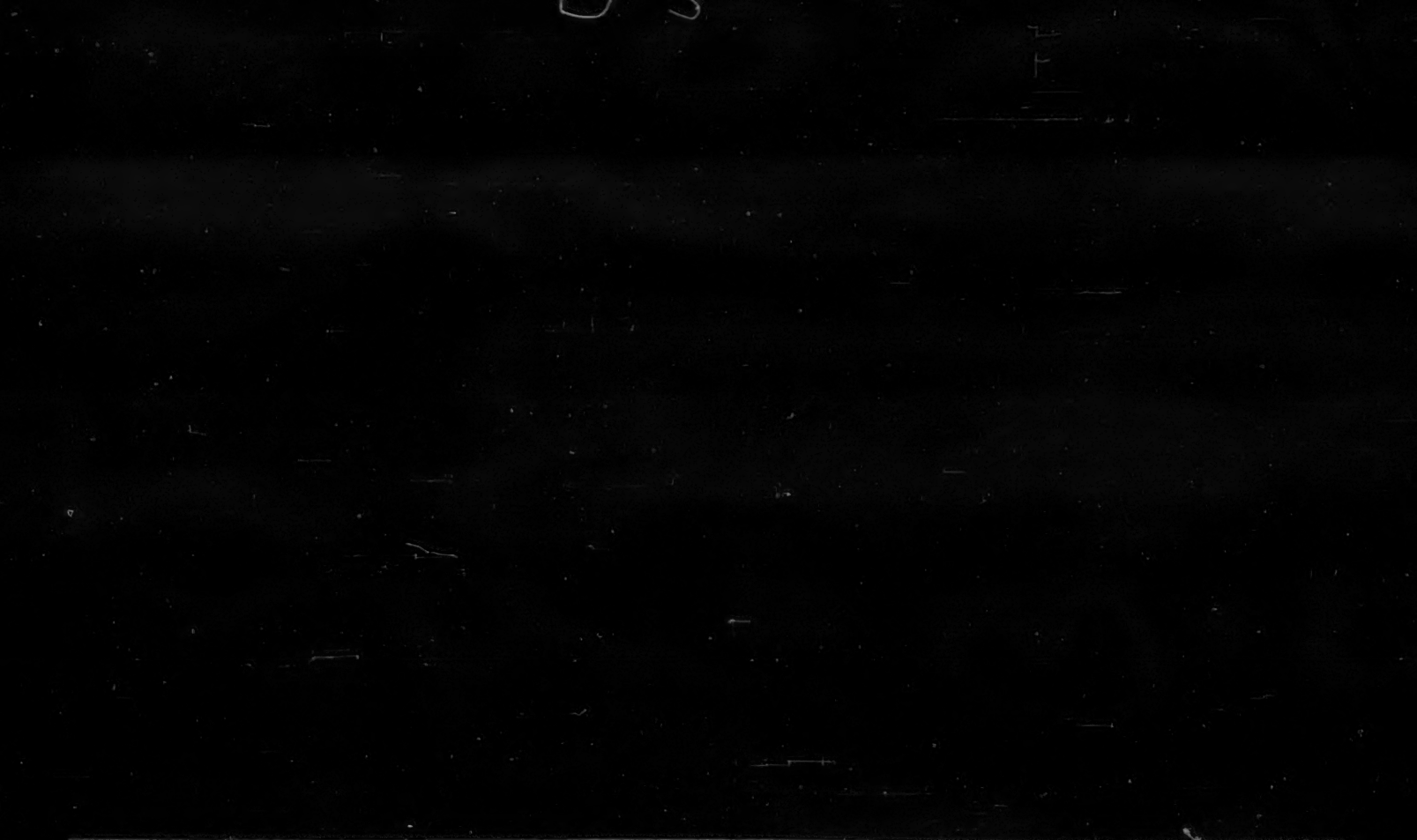

The American Midland Naturalist

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Records and Descriptions of North American Crane-Flies (Diptera)[1]

Part VIII. The Tipuloidea of Washington, 1

Charles P. Alexander

University of Massachusetts, Amherst

General Account

Washington, the extreme northwestern state of the union, is roughly rectangular in outline, its extreme east-west length being 360 miles, the greatest breadth 240 miles. The total area is 66,836 square miles, of which 2,291 are water. The extreme northern boundary is the 49th parallel of north latitude while much of its southern boundary is the Columbia River, extending to slightly below the 46th parallel. The western boundary is the Pacific Ocean; in the northwest, Juan de Fuca and other straits separate the state from Vancouver Island in British Columbia. The following account by Fisher (in *Climate and Man*, 1941) provides data of value in this survey.

"The Cascade Range, 50 miles or more wide, extends in a north-south direction from British Columbia to the Columbia River and divides the state into a western and an eastern part, whose areas are to each other as 2 is to 3. Several peaks are from 10,000 to 12,000 feet high, while Mount Rainier exceeds 14,000 feet. The Olympic Mountains are the highest in the Coast Range, reaching nearly 8,000 feet. In the northeast is a series of north-south ranges, while in the extreme east are the beginnings of the Rocky Mountains, including the Blue Mountains in the extreme southeast.

"The Columbia River enters the state in the northeast and drains all of eastern and part of southwestern Washington. The Chehalis, flowing westward through the Coast Range, drains a part of the west, south of Puget Sound. Other streams in the western part of the state drain into Puget Sound, the inland waters north to the Strait of Georgia, the Strait of Juan de Fuca, and the Pacific Ocean.

"The climate of Washington is modified greatly by the influence of the Pacific Ocean and the mountain ranges, which trend north and south and hence lie athwart the prevailing westerly air currents from the ocean as well as the easterly currents from the interior of the continent. Air reaching the

1 The preceding part under this general title was published in The American Midland Naturalist 39: 1-82, 1948.

References in the text refer to the bibliography at the conclusion of the general account.

In the report the author's name has been abbreviated to the initial "A" following records of specimens. M. M. Alexander—Mrs. Charles P. Alexander.

state from the west has acquired much water vapor in passing over the ocean and has a cooling effect in summer and is a warming influence in winter. The marine influence is most pronounced on the coast and decreases inland, especially on crossing the Cascade Range, yet even eastern Washington has milder temperatures than the northern Plains. The climate of the western part of the state is much milder than that of any other section of the continent in the same latitude.

"Precipitation is heaviest near the ocean and on the windward, or southwesterly, slopes of the mountains, and lightest on the leeward slopes. * * * The lowest mean annual temperature for any station is 38° F. at Paradise Inn, elevation 5,500 feet, on the south slope of Mount Rainier, and the highest is 55° at Mottinger, Benton County, on the Columbia River. Along the coast, temperatures are moderate and equable. * * * The average annual precipitation ranges from 6 inches at Hanford, in south-central Washington on the Columbia River, to 146 at Wynoochee Oxbow in the foothills south of the Olympic Mountains. Thus Washington has by far a greater range in precipatation than is found in any other state. The average annual snowfall ranges from 5 inches on the ocean coast to 600 at Paradise Inn, where the maximum depth on the ground has exceeded 27 feet."

Tipulidae have been collected in virtually all sections of the state but certain of the seven physiographic regions into which Washington is commonly divided are much more productive of these flies than are others. These more important regions may be discussed briefly.

The Pacific Coastal Plain.—This includes the narrow strip of land immediately adjoining the Pacific and the Juan de Fuca Strait. Many of the streams flowing from the Olympic Mountains and also streams from the Coast Range in Chehalis and Pacific counties cross the plain. Precipitation is unusually heavy, ranging from about 80 to 120 inches per year. Records from Harbor and Pacific counties pertain to this region. Particular attention is called to Ilwaco, in the extreme southwestern corner of the state, where Melander secured several Tipulidae of unusual interest.

The Olympic Mountains.—An almost circular group of mountains occupying much of the Olympic Peninsula, chiefly in Clallam, Jefferson, Mason, and Chehalis counties. These isolated mountains of the Coast Range are separated from the Cascades to the east by the Puget Sound Basin. Because of their special interest, stations in the Olympic National Park will be discussed in more detail later (under "Collecting Stations").

The Puget Sound Basin.—The broad depression lying between the Coast and Cascade Ranges, averaging about 50 miles in width, dissected for more than one-half its extent by the many branching arms of Puget Sound. Much of the land around the Sound is low, scarcely attaining 100 feet. Piper (1906) delimits the basin by the 2,300 foot contour line on the surrounding mountains. Most of the streams that cross the Basin rise in the Cascades where they commonly originate in glaciers high on the various maior peaks and flow into Puget Sound. The Cowlitz River, originating on Rainier, to-

gether with a few smaller streams in the southern part of the state flow into the Columbia River. Many Tipulidae have been taken at localities in the Basin, particularly in the vicinity of major cities such as Seattle, Tacoma and Olympia.

The Cascade Mountains.—The magnificent range of mid-Tertiary mountains, studded with younger near-recent volcanic peaks of imposing appearance, has long held a peculiar attraction to the botanist and zoologist. Within the state of Washington the mountains completely traverse it in a course that is slightly easterly of true north. The main uplift has altitudes ranging from about 6,000 to 7,000 feet. The peaks where collections of Tipulidae have been made, from north to south, include Mount Baker (10,750 feet), close to the Canadian border; Mount Rainier (14,408 feet), giant of the Cascade system and fourth highest mountain in the United States; and Mount St. Helens (9,671 feet), in the southwestern part of the state. No collections of Tipulidae from Mount Adams (12,307 feet) some 35 miles due east of St. Helens, are available to me at this time. The Cascades form the most important single topographic feature of the state and because of their height and the direction of the prevailing winds from off the Pacific, have a profound effect on the distribution of plant and animal life. These mountains function as a barrier between the west and east not so much from their altitude but primarily because of the difference in humidity on the two sides of the range. The low passes of the Cascades would permit a ready transfer of many species of plants and animals, including Tipulidae. Because of their great interest and importance, particular attention has been devoted to Mounts Baker, Rainier and St. Helens, and these are discussed more in detail later in this introductory account (under "Collecting Stations").

The Columbia Plains.—The great basaltic plains that cover much of eastern Washington, as well as adjoining states, include numerous stations where collections of Tipulidae have been made by Melander and others. The plains are traversed by the Snake and Yakima Rivers, tributaries of the Columbia. Stations where relatively numerous Tipulidae have been taken include the Yakima Valley (Brookman), Pullman, Spokane, Walla Walla, Wawawai, and other localities discussed throughout the report (Doane, Melander and others).

From the Okanogan Highlands, chiefly in Ferry and Stevens counties, and the Blue Mountains, in Columbia county, relatively few records of Tipulidae are now available and a fuller knowledge of these evidently interesting regions must depend on future collecting.

Biotic and Physical Provinces.—Van Dyke (1919, 1926, 1929, 1939) proposed the term "Vancouveran" for a faunal area that includes the northwestern coastal belt of North America, extending from southeastern Alaska southward through British Columbia and its coastal islands, the Puget Sound Basin of Washington, the Willamette Valley of Oregon, into coastal California, on the mountain slopes extending fully to the 5,000 foot level. Van Dyke describes this area as including one of the most peculiar of all northern

faunas and indicates that its closest relationships are with the Alleghenian in eastern North America and the Japano-Manchurian fauna in eastern Asia. The very wet region lying to the west of the Olympic and Coast Ranges is called by Van Dyke the Pacific Maritime subfauna. On the higher Cascades the life zones of the Boreal Region, the Arctic-Alpine, Hudsonian and Canadian, are found, as discussed later. Washington east of the Cascades is occupied chiefly by the semiarid Great Basin section of the Sonoran zone, with a fauna that Van Dyke considers to be a direct northward extension of the Neotropical.

Dice (1943) recognizes three of his biotic provinces within the state. He replaces the term "Vancouveran" by the earlier name Oregonian and indicates that it includes the coast ranges of the state, being delimited on the east by a line lying just beyond the crests of the Cascades. Dice arbitrarily places the alpine and subalpine zones of the latter in the Oregonian province while referring the still lower montane belt on the eastern slopes of the Cascades to his Palusian province which further embraces much of eastern Washington. The northeastern part of the state includes a part of the Montanian province which elsewhere covers much of northern Idaho, western Montana and thence extends northward into Alberta and British Columbia. The occurrence of various species of plants and animals characteristic of the Vancouveran biotic province far to the east, in cases reaching the continental divide in western Montana, has been noted by various students.

Fenneman (1931) classifies the state into its physical divisions, these agreeing closely with the other distributions above described. The Olympic Peninsula and Pacific Coastal Plain fall in his Pacific Border Province of the Pacific Mountain System while the Puget Sound Basin is his Puget Trough section. The Cascade Mountains within the state embrace the Northern Cascades Mountains section only. Southeastern Washington includes the Walla Walla Plateau section of the Columbia Plateaus Province. The Okanogan Highlands, previously mentioned, are a northern extension of the Rocky Mountain System.

In similar manner, Mulford, in Van Dersal (1938) classifies our country on the basis of plant-growth and soil regions and climatic provinces. In Washington, from west to east, his regions are the North Pacific Coast; Willamette Valley-Puget Sound; Cascade-Sierra Nevada; Columbia River Valley; Palouse-Bitterroot Valley, and in the northeast, the Northern Rocky Mountains.

Life Zones.—Several accounts of the life zones of Washington are available. For the entire state, Piper (1906: 33-65, colored map) provides the most complete account. Five zones are recognized in Washington, including those of the Boreal Region (Arctic-Alpine, Hudsonian and Canadian) on the higher mountains as discussed later for the Olympic Mountains and Mount Rainier. Western Washington from sea-level to the beginning of the Canadian zone at about 3,000 feet is Humid Transition. Northeastern Washington is chiefly timbered arid Transition, the southeastern part of the state timberless arid Transition. South-central Washington and the valleys of the Columbia River and its major tributaries are Upper Sonoran (Upper Austral).

Olympic Mountains.—Jones (1947) presents a detailed account of the Merriam life-zone concept, with particular reference to the Olympic Peninsula, basing his zonal limits on the distribution of indicator plants for the various zones. On the Olympic Peninsula he finds the following altitudinal ranges for the various zones.

Arctic-Alpine	5,000-7,000 feet and over.
Hudsonian	3,500-5,000 feet (with tongues as low as 2,500).
Canadian	1,500-3,000 feet.
Transition	Sealevel-1,500 feet.

Attention is called to the occurrence of Hudsonian elements at such low altitudes, in contrast with these in the Rocky Mountains (as Colorado, where the lower limits are at about 10,000 feet). This is correlated with the numerous low altitude glaciers in the mountains, two of which (Hoh and Jeffries Glaciers) extend down to the 3,400 foot level. I would call attention to the converse of this, that is, the occurrence of Canadian elements at higher altitudes in secluded positions (as at Deer Park, 5,400 feet).

Mount Rainier.—Several accounts of the life zones of the mountain are available (Flett, 1922; Jones, 1938; Taylor and Shaw, 1927). The following altitudinal ranges for the various zones are as given by Jones.

Arctic-Alpine	6,000-14,408 feet.
Hudsonian	4,500-6,000 feet.
Canadian	3,000-4,500 feet
Transition	2,000-3,000 feet.

Taylor and Shaw (1927) indicate that on the west side of the mountain Transition elements occasionally occur to 3,500 feet or even to 4,000 feet and further extend the altitudinal range of the Canadian zone to 4,500 or even to 5,000 feet (in the White River region northeast of the main summit). The upper limit of the Hudsonian zone is placed at or close to 6,500 feet.

Jones (1938: 9) states that the climax vegetation of the Hudsonian zone on Mount Rainier is the *Abies-Tsuga-Chamaecyparis* complex (Subalpine fir-Mountain hemlock-Alaskan cedar); the Canadian zone *Tsuga-Abies-Pinus* (Western hemlock-Amabilis fir-Western white pine). That of the Humid Transition area of the Transition zone a *Tsuga-Thuja* (Western hemlock-Western red cedar) climax with its *Pseudotsuga* (Douglas fir) subclimax.

General Survey of the Tipuloidean Fauna of Washington

Although much further work remains to be done before our knowledge of the crane-fly fauna of Washington may be considered as being fairly complete, sufficient progress has been made to warrant the preparation of the basic list presented at this time. The early collections made by Doane, Kincaid, Melander and others have been supplemented in recent years by extensive series of these flies taken chiefly by Fender, Townes and the writer, with the able assistance of their wives. The present list includes 254 species, to which numerous additions may be expected. The total for the state can scarcely be fewer than 350 or perhaps 400 species.

To date no species of Tanyderidae has been taken in Washington but the other smaller families commonly placed in the Tipuloidea, the Ptychopteridae and Trichoceridae, are unusually well represented. In the major family Tipulidae the genus *Tipula,* with 62 species, includes one of the most conspicuous elements in the fauna. Particular attention should be called to the abundance of forms in the tribe Pediciini, where no fewer than 32 species are included. This may be compared with the basic list for Utah where 10 species were reported or with the even poorer representation in the Mexican border states, as Arizona with 1 species and New Mexico with 2. The Pediciine crane-flies are essentially northern types and are unusually well represented in the Vancouveran region. The Hexatomini include relatively few forms (37) when compared with the greatly developed tribe Eriopterini, with 73 species.

The pioneer worker on the Tipulidae of western North America was Professor Rennie Wilbur Doane (1871-1942) who published a total of 50 entomological papers, of which 12 related to the Tipulidae. In these Doane described approximately 150 new species of which more than 90 fall in the great genus *Tipula.* Virtually all of the Doane species are from the West and a considerable number from the state of Washington. The most important of the Doane papers have been cited in the list of References (Doane, 1900, 1901, 1912). It may be indicated that the types of the species described in the 1900 paper, stated therein to be in the collection of the Washington State College, Pullman, are actually in the United States National Museum. I have examined these at various times since 1912, thanks to the early interest of the late Frederick Knab and John Merton Aldrich. I am further greatly indebted to Dr. Alan Stone and Dr. Henry K. Townes for making genitalic mounts and subsequent figures and comparisons of several of the more obscure and doubtful forms. The types of the species described in the 1901 paper, all belonging to the genus *Tipula* (with the exception of *Tipula rostellata* Doane which is a *Prionocera*) are preserved chiefly in the collection of the Washington State College, Pullman. The types of certain of the doubtful species in this series have been loaned to me for study in past years through the appreciated kindness of Professors Robert L. Webster and Maurice T. James. The remaining Doane types, including the further extensive series of Western *Tipula* described in 1912, remained in the Doane collection and, after his death, were presented to the California Academy of Sciences, San Francisco. In July 1946 I was privileged to study certain of the doubtful species in this series through the kindness of Dr. Edward S. Ross and Professor Edwin C. Van Dyke. As a result of all the above the identity of virtually all of the Doane species now seems settled but during the long period (1912-1946) between the first and last examinations of these types, a certain number of synonyms of his species have been created. It may be noted that Doane, himself, particularly in 1908, created synonyms of some of the species that he had described in 1900, also chiefly because the latter types were at that time unavailable for comparison.

Following his graduation from Stanford University in 1896, Doane went to the Washington State College, Pullman, where he taught Entomology and

Zoology from 1896 to 1901. He then became superintendent of the Fisheries Experiment Station, at Keyport, Washington, where he remained until 1905, when he returned to Stanford. The ten years spent in Washington enabled Doane to collect not only in the eastern part, including Pullman and Wawawai, but later in the quite different western section at and near Keyport. Fully as important as his own collections were the rich materials submitted to him for study by Professors C. V. Piper, Trevor Kincaid, and others (Doane, 1900, 1901).

As indicated elsewhere, undoubtedly the most distinguished Dipterologist to have lived in Washington was Dr. Axel Leonard Melander, who was on the staff of the Washington State College from 1904 to 1926. Dr. Melander took full advantage of his opportunity to collect in a region that at that time and as regards the Diptera was virtually unworked and unknown. Dr. John Merton Aldrich had an almost equally long period at the nearby University of Idaho, Moscow, (1893-1913) and undoubtedly collected in various places in Washington but very few of his records of Tipulidae are available to us.

Collecting Stations.—As has been done in the earlier parts under this general title, certain of the localities of particular interest where Mrs. Alexander and the writer have been able to collect in person are described below in some detail. Such collecting in Washington was done in 1946 and 1947, particularly the latter, when we were in the state between July 19th and August 15th, as discussed below.

1. Mount Rainier National Park. The magnificent Cascade peak, Rainier, located just to the west of the crest line reaches a height of 14,408 feet, being the highest peak in the entire northwestern United States. The Mount Rainier National Park includes 241,220 acres, of which approximately one-quarter is occupied by the mountain itself. At present there are 26 active glaciers on the mountain, covering a total of about 40 square miles.

The lowest altitude within the park proper is near the Ohanapecosh Hot Springs, in the southeastern corner, where it is about 1,600 feet. The lowland forests follow up the rivers to an altitude of approximately 3,500 feet. These dense stands of gigantic trees are comprised chiefly of Western hemlock, *Tsuga heterophylla* (Raf.) Sargent; Douglas fir, *Pseudotsuga taxifolia* (Poir.) Britt., and Western red cedar, *Thuja plicata* Lamb., with fewer individuals of white or grand fir, *Abies grandis* Lindl. At about 2,500 feet, the Amabilis or silver fir, *Abies amabilis* (Loud) Forbes; Noble fir, *Abies nobilis* Lindl., and the Western white pine, *Pinus monticola* Lamb., appear, becoming more characteristic of the intermediate forest zone extending up the mountain slopes to the subalpine meadows. Other conifers in this higher forest zone include the Alaskan cedar, *Chamaecyparis nootkatensis* (Lamb.) Spach., and the Mountain hemlock, *Tsuga Mertensiana* (Bong.) Carr.

In the open parklands of the subalpine country are found a great variety of dwarf shrubs and perennial herbs that have been discussed in detail by Jones (1938) and others. Many of the Hudsonian zone Tipulidae were

taken by sweeping this subalpine vegetation. The following plants are particularly characteristic of this zone. Avalanch lily, *Erythronium montanum* Wats.; Bistort, *Polygonium bistortoides* Pursh; Western pasque flower, *Anemone occidentalis* Wats.; Marsh marigold, *Caltha leptosepala* DC; Alaskan spirea, *Lutkea pectinata* (Pursh) Kuntze; Mountain cinquefoil, *Potentilla flabellifolia* Hook.; Pink heather, *Phyllodoce empetriformis* (Smith) D. Don.; White heather, *Cassiope Mertensiana* (Bong.) G. Don.; louseworts, *Pedicularis,* of several species; monkey-flowers, *Mimulus,* various species, but especially *M. Lewisii* Pursh; Sitka valerian, *Valeriana sitchensis* Bong.; together with various others, including *Claytonia* spp.; *Saxifraga* spp.; *Lupinus* spp.; shooting star, *Dodecatheon viviparum* Greene; Cusick's speedwell, *Veronica Cusickii* Gray, and various Compositae.

Crane-fly collecting on Rainier.—For more than half a century the mountain has attracted entomologists and insect collectors, some of whom have brought back specimens of the Tipulidae. Apparently the earliest of these was the distinguished botanist, Charles Vancouver Piper, who was on the mountain in August 1895 (Piper, 1906: 20) and there secured three noteworthy species of the genus *Tipula* that were later described by Doane (1901) as *Tipula calcarata, T. cervicula* and *T. helvocincta,* all being well-known and characteristic inhabitants of the Hudsonian zone. Dr. J. Chester Bradley was on Rainier in 1915 and thereafter. Dr. Harrison G. Dyar collected at Longmire Springs in June 1917.

The most distinguished Dipterologist to visit Rainier was Axel Leonard Melander, who, with Mrs. Melander, camped and tramped on virtually every accessible part of the great mountain over a period of many years (Melander, 1923). To Melander more than to any other person we owe our present satisfactory knowledge of the Diptera of Mount Rainier and, indeed, the state of Washington. Dr. C. L. Fox visited the mountain in 1919. Beginning in the 1940's there was a resumption of crane-fly collecting, begun by Dr. and Mrs. Henry K. Townes in 1940 and ending with the recent visit by Dr. and Mrs. Charles L. Remington, in late August 1947.

Mrs. Alexander and I have collected on Rainier in 1946 and 1947. The chief places investigated include Elbe, Longmire Springs, Paradise Valley, Ohanapecosh Hot Springs, Chinook Pass and Tipsoo Lake, Cayuse Pass, Yakima Park, and along the Wonderland Trail, starting at White River and following the trail to Yakima Park, a beautiful mountain walk that provided unusually rich crane-fly collecting. No collecting by the writer has been done at the other park campgrounds in the southwest and northwest sections of the Park. Since the park boundaries, as now constituted, are artificial and by no means delimit the actual mountain, a few stations in the orbit of Rainier but outside the park limits have been included as being from Rainier. These include Ashford and Elbe, along the Nisqually River to the southwest, as low as 1,200 feet; La Wis Wis, in the Columbia National Forest, due south of Ohanapecosh, altitude 1,300 feet; and the Naches River, on the Yakima road, due east of the park, at an altitude of 1,900 feet.

More specific data on the more important stations are given.

Elbe; Dutch's Creek and vicinity, on either side of the lower Nisqually River, altitude 1,200 feet; July 1947, August 1946. The station is Humid Transition and produced several interesting Tipulidae typical of this zone, including *Ptychoptera sculleni,* P. townesi,* Bittacomorphella fenderiana, Bittacomorpha occidentalis, Tipula* (*Trichotipula*) *repulsa, Dicranota* (*Dicranota*) *argentea, Gonomyia* (*Gonomyia*) *aciculifera, Erioptera* (*Psiloconopa*) *carbonipes, E.* (*P.*) *irata,* E.* (*P.*) *megarhabda, E.* (*P.*) *polycantha, E.* (*P.*) *recurva,* Ormosia* (*Ormosia*) *subcornuta,* and others. The species marked with an asterisk * were new to science when first discovered at this station. Labelled "Elbe."

Longmire Springs, southwestern section of park; altitude 2,800 feet; July 22-24, 1947, August 10-12, 1946; station highest Humid Transition or low Canadian. Particular attention should be called to the small stream flowing between the road into the campground and the Nisqually River. This brook rises on the hilly slopes across the road, crosses the latter through a culvert, and then flows parallel to the main stream for the hundred yards or so remaining. It is along this latter stretch that unusually fine crane-fly collecting was found, particularly in August 1946. Most of the Pediciine species recorded below were taken here. In July 1947 we again collected along this stream and were surprised at the great difference in the composition of the crane-fly fauna in exactly the same habitat. Virtually all of the Pediciini so common and conspicuous the preceding year were quite lacking and by far the commonest were two species of *Limonia, bistigma* and *sciophila,* particularly the former. Tipulidae from Longmire include *Tipula* (*Schummelia*) *subtenuicornis, T.* (*Vestiplex*) *tacomicola,* T.* (*Oreomyza*) *shoshone, Elliptera astigmatica, Pedicia* (*Pedicia*) *parvicellula, P.* (*Tricyphona*) *townesiana, Dicranota* (*Rhaphidolabis*) *stigma,* D.* (*R.*) *xanthosoma, D.* (*Plectromyia*) *cascadica,* D.* (*P.*) *reducta, Paradelphomyia* (*Oxyrhiza*) *pacifica, Dactylolabis nitidithorax, Limnophila* (*Prionolabis*) *paramunda,* L. indistincta, Rhabdomastix* (*Sacandaga*) *subfasciger, R.* (*S.*) *trichophora, Erioptera* (*Gonomyodes*) *tacoma,* E.* (*Psiloconopa*) *irata,* Ormosia* (*Rhypholophus*) *fumata, O.* (*O.*) *decussata, Molophilus* (*Molophilus*) *distilobatus,* and others. Labelled "Longmire."

Paradise Valley (Paradise Park), southwestern section of park, above Longmire; altitude 5,500-5,600 feet; July 23, 1947, August 11, 1946. The subalpine meadows where many Hudsonian zone Tipulidae were taken here and under comparable conditions elsewhere on the mountain (as at Tipsoo Lake and Yakima Park, discussed later) have been described earlier. Conditions definitely Hudsonian or, in secluded places, highest Canadian. The Tipulidae include *Tipula* (*Yamatotipula*) *cervicula,* T.* (*Y.*) *spernax lanei, T.* (*Arctotipula*) *plutonis absaroka, T.* (*Oreomyza*) *helvocincta,* T.* (*O.*) *pseudotruncorum,* T.* (*Lunatipula*) *calcarata,* Limonia* (*Dicranomyia*) *acerba,* Elliptera astigmatica, Pedicia* (*Tricyphona*) *smithae,* P.* (*T.*) *tacoma,* Limnophila* (*Phylidorea*) *bigladia, L.* (*P.*) *claggi, Gonomyia* (*Gono-*

myia) *bihamata, E.* (*Mesocyphona*) *melanderiana,* E.* (*Psiloconopa*) *rainieria,* Ormosia* (*Rhypholophus*) *bifidaria, O.* (*R.*) *paradisea,* O.* (*O.*) *absaroka, O.* (*O.*) *onerosa, Molophilus* (*Molophilus*) *kulshanicus,* M.* (*M.*) *spiculatus, M.* (*M.*) *rainierensis,** and others. Labelled "Paradise Valley."

Chinook Pass and Tipsoo Lake, 5,350-5,450 feet, and Yakima Park, 6,400 feet, on east side of park; July 28-August 3, 1947; conditions Hudsonian; Tipulidae much as listed under Paradise Valley.

White River Camp, on the White River, about one mile below the snout of Emmons' Glacier; east side of park, altitude 4,400 feet; July 29, 1947; conditions Canadian. Collections made by sweeping beds and scattered clumps of mountain alder (*Alnus sinuata* Regel) on the river bars, these clumps interspersed with scattered willow, pearly everlasting, *Anaphalis margaritacea* (L.) Benth. & Hook., *Mimulus Lewisii*, and stunted *Lutkea pectinata*. Some of the more interesting Tipulidae taken here included *Rhabdomastix* (*Sacandaga*) *trichophora, Gonomyia* (*Gonomyia*) *aciculifera, G.* (*G.*) *percomplexa, Erioptera* (*Hesperoconopa*) *dolichophallus, E.* (*Gonomyodes*) *tacoma,* E.* (*Psiloconopa*) *margarita,* and others. Labelled "White River."

Naches River, outside the Park limits, to the east; altitude 1,900 feet, July 28 and 31, 1947; station arid Transition. Tipulidae, all swept from low vegetion along the river bank, included *Nephrotoma occipitalis, Tipula* (*Yamatotipula*) *nuntia, T.* (*Oreomyza*) *yellowstonensis, Limonia* (*Dicranomyia*) *brevivena, Rhabdomastix* (*Sacandaga*) *leonardi, Cryptolabis* (*Cryptolabis*) *bisinuata, Erioptera* (*Psiloconopa*) *shoshone, Molophilus* (*Molophilus*) *harrisoni,* and others. A distinctive Rocky Mountain element present. Labelled "Naches River."

2. Mount Baker. This peak, most northerly of the Cascades, was visited in 1947. We collected at Galena Camp, in Heather Meadows, between August 8th and 15th. Due to very rainy weather no adequate collections could be secured and the record provided at this time must be considered as being partial only. Conditions at the camp, located on Galena Creek, altitude 4,000 feet, were definitely Hudsonian, most of the plants being of the same species as those recorded earlier under comparable conditions on Mount Rainier (Muenscher, 1938; St. John & Hardin, 1929). Tipulidae secured at or near the camp include *Tipula* (*Yamatotipula*) *cervicula, T.* (*Y.*) *continentalis, T.* (*Oreomyza*) *helvocincta, Limonia* (*Limonia*) *sciophila, L.* (*Dicranomyia*) *halterata, Elliptera astigmatica, Pedicia* (*Pedicia*) *parvicellula, P.* (*Tricyphona*) *aperta, P.* (*T.*) *degenerata, P.* (*T.*) *diaphana, P.* (*T.*) *protea, Dicranota* (*Rhaphidolabis*) *cayuga, D.* (*R.*) *subsessilis, D.* (*Plectromyia*) *kulshanensis,* D.* (*P.*) *reducta, Phyllolabis fenderiana,* P. lagganensis, Limnophila* (*Elaeophila*) *aldrichi, L.* (*Phylidorea*) *claggi, L.* (*P.*) *aequiatra,* Neolimnophila ultima, Rhabdomastix* (*Sacandaga*) *subcaudata. E.* (*Mesocyphona*) *melanderiana, E.* (*Psiloconopa*) *rainieria, Ormosia* (*Rhypholophus*) *bifidaria, O.* (*R.*) *suffumata, O.* (*O.*) *onerosa, Molophilus* (*Molophilus*) *kulshanicus,* and others. Labelled "Galena Camp."

Further collections were made nearer the foot of the mountain at Silver Fir Camp, altitude 1,990 feet, August 13 and 15, 1947. This camp is on the North Fork of the Nooksack River, a fiercely flowing mountain torrent that rises from a glacier high up on the eastern slopes of Mount Shuksan, the gigantic mate peak of Mount Baker. Several species of Tipulidae not found elsewhere in the state were taken here, including *Diazosma subsinuata, Tipula* (*Oreomyza*) *fallax, T.* (*Lunatipula*) *unicincta, Limonia infuscata, Dicranota* (*Rhaphidolabis*) *nooksackensis,* D.* (*Plectromyia*) *nooksackiae,* Crypteria americana, Rhabdomastix* (*Sacandaga*) *trichophora, Erioptera* (*Empeda*) *alicia, E.* (*Psiloconopa*) *carbonipes, E.* (*P.*) *crassivena,* E.* (*P.*) *irata,* E.* (*P.*) *megarhabda, E.* (*Hesperoconopa*) *dolichophallus, Molophilus* (*Molophilus*) *perflaveolus,* and others. Conditions here are Humid Transition. Labelled "Silver Fir Camp."

3. Olympic National Park. The great primitive area on the Olympic Peninsula embraces 835,411 acres. We camped at the Olympic Hot Springs, altitude 2,200 feet, August 4th to 8th, 1947. Due to almost constant rain only a preliminary survey of the Tipulidae of this evidently rich area could be made. Two stations deserve special consideration.

Trail from Olympic Hot Springs to Boulder Lake. We collected along this attractive mountain trail on August 5th. Near the start, immediately above the camp, altitude 2,200 feet, is an extensive swampy area shaded with Western Hemlock and Western Red Cedar, with abundant skunk cabbage, *Lysichitum americanum* Hulten & St. John. Associated plants include the deer fern, abundant giant horsetail, *Equisetum Telmateia* Ehrh., a species of *Veratrum,* and others. Around the swamp margin grow sparse alder and devils club. Tipuloidea were numerous in and about this area but owing to the heavy rains, probably only a fraction of the species actually occurring were secured. These included *Ptychoptera lenis, P. sculleni, Diazosma subsinuata, Tipula* (*Bellardina*) *aspersa, Limonia* (*Limonia*) *bistigma, L. infuscata, L.* (*Dicranomyia*) *gracilis, L.* (*D.*) *halterata, L.* (*Discobola*) *elegans, Ula* (*Ula*) *paupera, Pedicia* (*Tricyphona*) *constans, Dicranota* (*Rhaphidolabis*) *xanthosoma, Paradelphomyia* (*Oxyrhiza*) *pacifica, Limnophila indistincta, Ulomorpha nigrodorsalis,* U. sierricola,* and others. Conditions here are Humid Transition. Higher up the trail at about 3,500 feet, a small mountain stream crosses the path. Some further interesting Tipulidae were taken here, including *Pedicia* (*Tricyphona*) *protea, P.* (*T.*) *unigera,* Dicranota* (*Plectromyia*) *kulshanensis,*Dactylolabis nitidithorax,* and others. Conditions here are definitely Canadian. Despite the low altitude of Boulder Lake, 4,000 feet, conditions are definitely Hudsonian, as shown by the presence of numerous indicator plant species and certain Tipulidae, as *Pedicia* (*Tricyphona*) *smithae.*

Deer Park; altitude 5,400 feet; August 6, 1947. Despite the higher altitude, conditions here were Canadian and definitely less boreal than at Boulder Lake. Several interesting crane-flies were secured, including *Diazosma subsinuata, Limonia* (*Limonia*) *sciophila, L.* (*Dicranomyia*) *athabascae, L.* (*D.*)

vulgata, Pedicia (*Tricyphona*) *degenerata, Dicranota* (*Rhaphidolabis*) *cayuga, D.* (*R.*) *neomexicana,* D.* (*Plectromyia*) *reducta, Dactylolabis sparsimacula, Limnophila* (*Phylidorea*) *olympica,* Gonomyia* (*Gonomyia*) *bihamata, G.* (*G.*) *isolata,* Ormosia* (*Ormosia*) *albertensis, O.* (*O.*) *pugetensis, Molophilus* (*Molophilus*) *distilobatus, M.* (*M.*) *rainierensis,* and others. Labelled "Deer Park."

4. Mount Saint Helens. This peak is reached from Spirit Lake, western entrance to the Columbia National Forest. We camped at the latter between July 19th and 22nd, 1947. Besides collecting at Spirit Lake, altitude 3,200 feet, further materials were taken at various places along the Toutle River, outlet of the lake, to as low as 2,000 feet near Elk Creek in Cowlitz county. Conditions ranged from lowest Canadian at the lake down into Humid Transition. Special attention was devoted to timberline, altitude 4,300 feet, on Saint Helens, July 21, 1947, where conditions are Hudsonian, passing above into Arctic-Alpine. The Tipulidae at timberline included *Tipula* (*Oreomyza*) *pseudotruncorum, Pedicia* (*Tricyphona*) *aperta, P.* (*T.*) *smithae, Dicranota* (*Rhaphidolabis*) *integriloba, Rhabdomastix* (*Sacandaga*) *subfasciger, R.* (*S.*) *trichophora, Ormosia* (*Rhypholophus*) *bifidaria, O.* (*O.*) *onerosa, Molophilus* (*Molophilus*) *perflaveolus,* and others. Labelled "St. Helens, timberline."

It may be noted that in the treatment of species under the "Systematic Account," records for Mount Baker, Olympic National Park, Mount Rainier and Mount Saint Helens are arranged in that order under the individual species and precede any further miscellaneous records for the remainder of the state.

The Walla Walla Problem. Under this caption I wish to discuss a puzzling situation as regards the distribution of Washington Tipulidae. Walla Walla lies in Walla Walla County, in southeastern Washington, just west of the Blue Mountains, at an altitude of between 950 and 1,000 feet. In the later list of species the following records of Tipulidae from Walla Walla will be found.

Tipula (*Trichotipula*) *oropezoides*—August 18, 1923 (*Melander*).
Tipula (*Vestiplex*) *longiventris*—August 18, 1923 (*Melander*).
Pseudolimnophila contempta—May 28, 1938 (*M. C. Lane*).
Gnophomyia tristissima—July 2-6, 1922 (*Melander*).

All four of these flies are characteristic eastern Nearctic species that have never been taken within hundreds of miles of Washington. While the chances for mislabelling of materials might have occurred in a single case, it should be noted that two distinct collectors and three different years are involved in the above records. Somewhat comparable puzzling records of occurrences of other eastern insects in the western states have been recorded in recent years (as the Mecopterous genus *Panorpa* in Utah and Oregon) and it seems apparent that more evidence in the matter should be forthcoming before such records are finally accepted or discarded. The most dubious of the above records are the two species of *Tipula* since not only is the locality in question but the date of occurrence likewise suggests a mistake in labelling.

Collectors and Localities.—A summary of the known collectors of Tipuloidea in Washington is given herewith. Throughout the text, specimens taken by Melander are indicated by the letter "M"; those collected by Mrs. Alexander and the writer by the letter "A." The asterisk indicates the more important collectors.

Aldrich, John M.
*Alexander, Charles P.
*Alexander, Mabel M.
Argo, V.
Arnaud, Paul H.
Bradley, J. Chester
*Brookman, B.
Campbell, M. L.
*Doane, Rennie W.
Dolley, J. S.
*Dyar, Harrison G.
Dybas, Henry
*Fender, Dorothy M.
*Fender, Kenneth M.
Fox, C. L.
Giles, William
Gurney, Ashley B.
James, Maurice T.
*Kincaid, Trevor
Knowlton, George F.
Lane, Merton C.
Macnab, James A.
Mason, J. I.
*Melander, Axel L.
Melander, Ivar
Morrison, Herbert K.
Piper, Charles V.
Remington, Charles L., and J.
Shackleford, Martha W.
Shannon, Raymond C.
Shelford, Victor E.
Smith, E. I.
Smith, Marion E.
*Townes, Henry K., and M.
Van Duzee, Edward P.

In order to avoid constant repetition throughout the text, the various stations where Tipuloidea have been taken, together with their county and approximate altitude, are listed herewith. Most of the altitudes have been taken from the American Guide Series volume on "Washington," cited in the References. For stations where we have collected in person, altitudes have been taken or confirmed by altimeter.

Adams, Mount, Yakima Co.
Adna, Lewis Co.
Alder Lake, Elbe, Lewis Co., 1,200 ft.
Alta Vista, Mt. Rainier
Almota, Whitman Co.
Ararat, Mt., Mt. Rainier, 5,300 ft.
Ashford, Pierce Co., 1,770 ft.
Asotin, Asotin Co., 760 ft.

Bagley Creek Camp, Mt. Baker, 2,500 ft.
Baker, Mount, Whatcom Co.
Barnes State Reservation, Cowlitz Co.
Bellingham, Whatcom Co.
Berkeley Park, Mt. Rainier
Big-4 Mountain, Snohomish Co.
Bird Creek Meadows, Mt. Adams
Blaine, Whatcom Co., 40 ft.
Blewett, Chelan Co., 2,325 ft.
Blyn, Clallam Co., 300 ft.
Boulder Lake Trail, Olympic National Park
Brinnon, Jefferson Co.
Burroughs Mt., Mt. Rainier

Canyon Creek
Carson, Skamania Co., 100 ft.
Cascade Lake, Orcas Island
Castle Rock, Cowlitz Co., 50 ft.
Cayuse Pass, Mt. Rainier, 4,300 ft.
Chelan, Lake, Chelan Co., 1,080 ft.
Chinook Pass, Mt. Rainier, 5,440 ft.
Christine Falls, Mt. Rainier, 3,665 ft.
Clarkston, Asotin Co., 825 ft.
Colville, Lake, Lincoln Co.
Crescent, Lake, Clallam Co., 580 ft.
Cushman, Lake, Mason Co., 735 ft.

Deer Park, Olympic National Park, 5,400 ft.
Diamond Lake, Pend Oreille Co.
Dutch's Creek, near Elbe, Lewis Co., 1,200 ft.

Eagle Peak, Mt. Rainier
East Port Orchard, Kitsap Co.
Elbe, Pierce Co., 1,210 ft.
Ellensburg, Kittitas Co., 1,520 ft.
Entiat, Chelan Co., 690 ft.
Everett, Snohomish Co., 30 ft.

Five-mile Lake
Forks, Clallam Co., 375 ft.
Fort Lewis, Pierce Co.

Galena Camp, Mt. Baker, 4,000 ft.
Glacier, Whatcom Co.
Grand Coulee, Grant Co., 1,585 ft.
Grotto, King Co., 820 ft.

Hansen Camp, Mt. Rainier
Heather Meadows, Mt. Baker (Galena Camp), 4,000 ft.
Holland
Hoodsport, Mason Co., sea-level
Hoquiam, Grays Harbor Co., 300 ft.

Ilwaco, Pacific Co., sea-level
Index, Snohomish Co., 530 ft.
Indian Henry, Mt. Rainier

Kachess Lake, Kittitas Co.
Keechelus Lake, Kittitas Co., 2,475 ft.
Kelso, Cowlitz Co., 22 ft.
Kennewick, Benton Co., 355 ft.
Keyport, Kitsap Co., 25 ft.
Knightmore

La Center, Clark Co., 250 ft.
Lake Union, Seattle, King Co.
Lewis and Clark State Park, Lewis Co.
Lilliwaup, Mason Co., 15 ft.
Lind, Adams Co., 1,365 ft.
Longmire Springs, Mt. Rainier, 2,800 ft.
Longview, Cowlitz Co., 15 ft.
Loon Lake, Stevens Co.
Lowden, Walla Walla Co., 490 ft.
Lucerne, Lake Chelan, Chelan Co.
Lyle Grove, Pullman, 100 ft.

Manchester
Mazama Ridge, Mt. Rainier
McCleary, Grays Harbor Co., 285 ft.
Merritt, Chelan Co., 2,185 ft.
Mica, Spokane Co.
Mill Creek, Walla Walla Co., 955 ft.
Montesano, Grays Harbor, 65 ft.
Moxee, Yakima Co., 1,000 ft.
Mt. Vernon, Skagit Co., 25 ft.

Naches, Yakima Co., 1,815 ft.
Narada Falls, Mt. Rainier
Nasel River
Nooksack River, Mt. Baker, Whatcom Co.
North Bend, King Co., 455 ft.

Ohanapecosh Hot Springs, Mt. Rainier, 1,900 ft.
Olympia, Thurston Co., 70 ft.
Olympic Hot Springs, Olympic National Park, 2,200 ft.

Paradise Park (Valley), Mt. Rainier,
Pluvius, Lewis Co., 745 ft.
Pine Canyon, Douglas Co., 2,800 ft.
Port Angeles, Clallam Co., 50 ft.
Potlatch, Hood Canal, Mason Co., sea-level
Puget, Thurston Co.
Pullman, Whitman Co., 2,345 ft.

Quilcene, Jefferson Co., 30 ft.
Quinault, Lake, Grays Harbor, 200 ft.

Rainier, Mount, Pierce-Lewis Cos.
Ramparts, Mt. Rainier
Rose Springs, Blue Mts.

Saint Helens, Mt., Skamania Co.
Saints Rest, Pullman, Whitman Co., 2,345 ft.
Seattle, King Co., 12-515 ft.
Selah, Yakima Co., 1,110 ft.
Shelton, Mason Co., 20 ft.
Shine, Jefferson Co., sea-level
Silver Fir Camp, Mt. Baker, 1,990 ft.
Sluiskin, Mt. Rainier
Snoqualmie Pass, King Co., 3,000 ft.
Spirit Lake, Mt. St. Helens, Skamania Co., 3,200 ft.
Sprague, Lincoln Co., 1,890 ft.
Squaw Lake, Mt. Rainier, 5,000 ft.
Stanwood, Snohomish Co., 5 ft.
Stehekin, Lake Chelan, Chelan Co., 1,080 ft.
Stillaguamish River, Snohomish Co.
Sultan, Snohomish Co., 115 ft.
Summerland, Mt. Rainier, 5,900 ft.
Swauk Creek, Chelan Co.
Tacoma, Pierce Co., 20 ft.
Texaco Pond, Mt. Rainier, east, 2,000 ft.
Tipsoo Lake, Mt. Rainier, 5,350 ft.
Tokeland, Pacific Co., sea-level
Toledo, Lewis Co., 140 ft.
Toutle River, Spirit Lake, Skamania-Cowlitz Cos.
Tulalip, Snohomish Co., 20 ft.
Twanoh State Park, Hood Canal, Mason Co.

Union Flat, Kitsap Co., 10 ft.
Union Gap, Yakima Co., 930 ft.
Valleyford, Spokane Co.
Vancouver, Clark Co., 115 ft.
Van Trump, Mt. Rainier

Walker's Park, Shelton, Mason Co., 20 ft.
Walla Walla, Walla Walla Co., 955 ft.
Wawawai, Whitman Co., 2,400 ft.
Wenatchee, Chelan Co., 640 ft.
White River Camp, Mt. Rainier, 4,400 ft.

Wind River Experimental Forest, Skamania, 100 ft.
Wis Wis, La, Columbia National Forest, 1,300 ft.
Yakima, Yakima Co., 1,075 ft.
Yakima Park, Mt. Rainier, 6,400 ft.
Yukon Camp, Grotto, King Co., 820 ft.
Zillah, Yakima Co., 820 ft.

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———1939—The origin and distribution of the Coleopterous insect fauna of North America. Sixth Pacific Science Congress, Proc. 4: 255-268, map (map shows the faunal zones of North America, including the Vancouveran).

Systematic Account

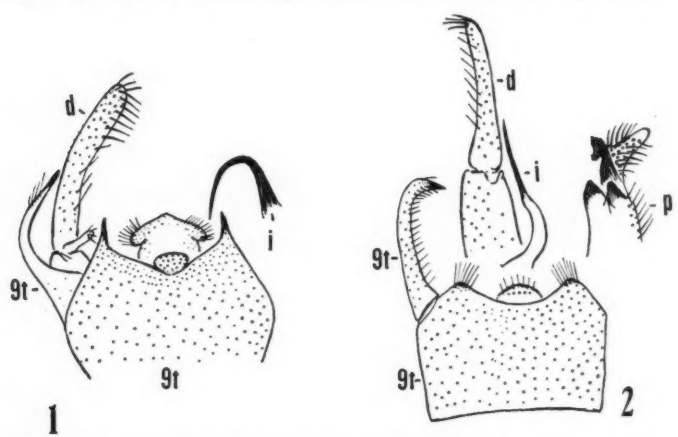
PTYCHOPTERIDAE

Ptychoptera lenis Osten Sacken, 1877.—Olympic National Park: Olympic Hot Springs, 2,200 ft., August 7, 1947 (*A*). Mt. Rainier: Longmire Springs, June 1917 (*Dyar*), July 30, 1922 (*M*). Olympia, July 27, 1924 (*M*); Valleyford, May 17, 1924, June 19, 1919 (*M*).

Ptychoptera sculleni Alexander, 1943.—Olympic National Park: Olympic Hot Springs, 2,200 ft., August 7, 1947 (*A*). Mt. Rainier: Elbe, July 15-18, 1940 (*Townes*); types.

Ptychoptera townesi Alexander, 1943.—Mt. Rainier: Elbe, July 13, 1940 (*Townes*); type. Everett, July 6, 1924 (*M*); Pluvius, July 16, 1922 (*M*); Puget, July 4, 1925 (*M*); Swauk Creek, June 28, 1924 (*M*); Toledo, June 27, 1935 (*M*).

Bittacomorphella fenderiana Alexander, 1947.—Mt. Rainier: Ashford, August 18, 1940 (*Townes*); type material; Dutch's Creek, Elbe, 1,200 ft.,



Figs. 1-2.—1. *Bittacomorphella fenderiana* Alexander, male hypopygium; 2. *Bittacomorphella sackeni* Röder, male hypopygium. (Symbols: *d*, dististyle; *i*, interbase; *p*, phallosome; *t*, tergite).

July 24, 1947 (*A*). Keyport, July 1905 (*Doane*); Lake Union, Seattle, August-September 1894 (*Aldrich*); Lewis & Clark State Park, September 28, 1946 (*Fender*), type material. The male hypopygium is figured (Fig. 1).

Bittacomorphella sackeni (Röder, 1890).—Mt. Rainier: Summerland, July 24, 1924 (*M*); July 21, 1940 (*Townes*). Everett, July 4, 1924 (*M*); Lewis & Clark State Park, September 28, 1946 (*Fender*). The male hypopygium (Fig. 2) is illustrated.

Bittacomorpha occidentalis Aldrich, 1895.—Mt. Rainier; July 8, 1940 (*Townes*); below Paradise Valley, 4,000 ft., August 11, 1946, common in a bog of *Pedicularis surrecta* Bentham (*A*); Dutch's Creek, Elbe, 1,200 ft., July 24, 1947 (*A*); Ashford, August 18, 1940 (*Townes*). Seattle (*Kincaid*).

TRICHOCERIDAE

Diazosma subsinuata (Alexander, 1915).—Washington State (Morrison); in Bigot Collection. Mt. Baker: Silver Fir Camp, August 13, 1947 (*A*). Olympic National Park: Olympic Hot Springs, August 7, 1947 (*A*), Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Longmire Springs, August 24, 1925 (*M*). Lewis & Clark State Park, August 20, 1944 (*Knowlton*).

Paracladura trichoptera (Osten Sacken, 1877).—Barnes State Reservation, September 27, 1946 (*Fender*); East Port Orchard, September 23-26, 1946 (*Fender*); Ilwaco, May 5, 1918 (*M*).

Trichocera colei Alexander, 1919.—Vancouver, December 12,1918 (*William Giles*), reared from turnips.

Trichocera columbiana Alexander, 1927.—Mt. Baker: Galena Camp, 4,000 ft., August 11, 1947 (*A*). Mt. Rainier: Longmire Springs, June 14, 1917 (*Dyar*). Twanoh State Park, September 22, 1946 (*Fender*).

Trichocera garretti, 1927.—Mt. Rainier: Paradise Park, August 1917 (*M*).

Trichocera hyaloptera sp. nov.—Allied to *tetonensis;* general coloration of thorax and abdomen dark brown; knobs of halteres dark brown; wings whitish, entirely unpatterned, veins relatively pale and inconspicuous; male hypopygium with the dististyle long and slender, approximately one-half longer than the basistyle, on mesal face at near one-third the length with a pale compressed blade.

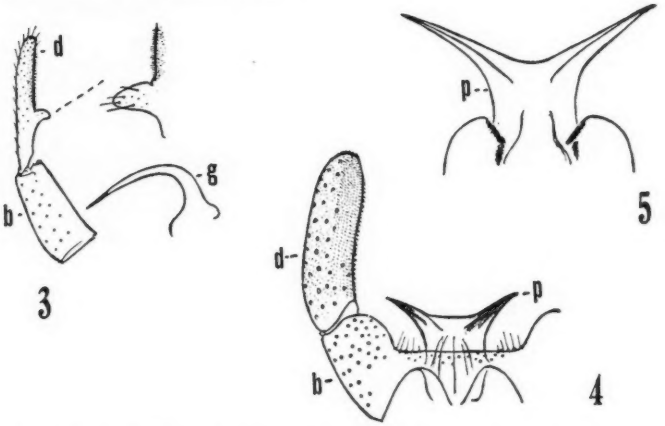
♂. Length, about 4-4.3 mm.; wing, 5.2-5.5 mm.; antenna, about 3 mm.

Rostrum and palpi black. Antennae relatively long, exceeding half the length of body, dark brown throughout. Head brownish gray.

Thorax almost uniformly dark brown, the center of the pronotum and the pretergites more brightened; scutellum with posterior border yellow. Halteres with stem pale, knob dark brown. Legs with the coxae and trochanters yellowish testaceous, remainder of legs brown, the femoral bases paling to yellow. Wings with a whitish tinge, even paler at base, entirely unpatterned; veins pale

brown, inconspicuous against the ground. Venation: Sc_1 ending shortly before R_2; R_{2+3+4} about one-third longer than R_{2+3}; cell M_1 from one-third to one-half longer than its petiole; cell *2nd A* broad.

Abdomen, including the hypopygium, dark brown, the pleural membrane paler. Male hypopygium (Fig. 3) with the fusion of the lobes of the basistyle, the so-called "coxal bridge," complete, produced into a small darkened lobe at point of union. Distitstyle, *d*, long and slender, approximately one-half longer than the basistyle; on mesal face at near one-third the length with a pale compressed blade that is provided with several pale setae; mesal face of style distad of the blade with abundant erect setulae. Gonapophyses appearing as unusually long yellow blades.



Figs. 3-5.—3. *Trichocera hyaloptera* sp. nov., male hypopygium; 4. *Trichocera setosivena* Alexander, male hypopygium; 5. *Trichocera longisetosa* Alexander; male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *p*, phallosome).

Holotype, ♂, Peavine Ridge, Yamhill Co., Oregon, Station 3 A, October 12, 1946 (*Fender*). *Paratopotypes*, ♂♂, October 12-23, 1945, Station 3 (*Fender*); February 16-April 14, 1946 (*Fender*). *Paratypes*, 1 ♂, on slide, Longmire Springs, Mt. Rainier, Washington, 2,800 feet, August 23, 1947 (*Remington*); 1 ♂, East Port Orchard, Washington, September 25, 1946 (*Fender*).

The present fly is most similar to *Trichocera garretti* Alexander, 1927, and *T. tetonensis* Alexander, 1945, especially the latter, differing most evidently in the whitish subhyaline wings that are entirely unpatterned. The structure of the male hypopygium is somewhat more as in *tetonensis* yet differs in details of vestiture of the dististyle.

Trichocera longisetosa Alexander, 1927.—Lake Cushman, June 27, 1917 (*Dyar*); type. Still known to me only from the unique type. I am greatly indebted to Dr. Alan Stone for making re-examinations of the types of this

species and *Trichocera setosivena*, as discussed later under the latter species. The figures here provided are based on sketches made by me at the time of describing the two species, with additions concerning *setosivena* based on a camera lucida drawing by Dr. Stone.

Trichocera saltator (Moses Harris, 1782).—Above Galena Camp, 4,300 ft., August 11, 1947 (*A*). Mt. Rainier: Woodland Trail, above White River Camp, 5,700 ft., August 1, 1947 (*A*).

Trichocera setosivena Alexander, 1927.—Olympic National Park: Boulder Lake Trail, 2,300 ft., August 5, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Fort Lewis, January 2-6, 1946 (*Arnaud*); Pluvius, July 10, 1917 (*M*); Twanoh State Park, September 22, 1946 (*Fender*).

The species was described from southern Alaska, now known to be common and widely distributed in the Vancouveran region as far south as Oregon. As indicated under *Trichocera longisetosa*, I am providing figures showing the male hypopygia of the two species. In *setosivena*, *Sc* is long, Sc_1 ending nearly opposite to just before vein R_2; R_{2+3+4} relatively short, approximately one-half R_{2+3}. The male hypopygium (Fig. 4) has the coxal bridge complete; dististyle unarmed; horns of the phallosome (gonapophyses) relatively short and stout, shorter than the transverse diameter of the stem of the phallosome. In *longisetosa*, *Sc* is shorter, Sc_1 ending about opposite midlength of R_{2+3}; R_{2+3+4} long, slightly exceeding R_{2+3}. The male hypopygium (Fig. 5) is almost as in *setosivena*, the only evident difference being in the longer horns of the phallosome which are approximately equal in length to the width of the stem of the phallosome. Despite the differences indicated, I must regard the two flies as being very closely allied.

TIPULIDAE

TIPULINAE

Holorusia (*Holorusia*) *grandis* (Bergroth, 1888) (*rubiginosa* Loew, 1863, preoccupied).—Mt. Rainier: Ohanapecosh Hot Springs, 1,900 ft., July 30, 1947 (*A*). Asotin, May 19, 1923 (*V. Argo*); Diamond Lake, June 15, 1924 (*M*); Pine Canyon, June 28, 1924 (*M*); Seattle (*Kincaid*).

Phoroctenia vittata angustipennis (Loew, 1872) (*similis* Williston, 1894).—Mt. Rainier: Paradise Valley, 5,000-6,000 ft., July 28, 1919 (*C. L. Fox*). Montesano, April 19, 1941 (*M. L. Campbell*); Seattle, April 10, 1901, April 17, 1898, May 11, 1937, May 24, 1933, June 25, 1909 (all *Kincaid*). Williston (1894) described from "Washington" a species *Ctenophora similis*, indicated as differing from *angustipennis* in its shining black mesonotum, more extensive darkened pattern of the abdomen, and increased amount of dark color on the legs. All such characters come within the normal color range of the subspecies and the name *similis* must be considered as being a synonym. The generic name *Phoroctenia* Coquillett, 1910, with the present subspecies as type, antedates *Malpighia* Enderlein, 1912.

Nephrotoma occidentalis (Doane, 1908).—Longview, August 10, 1947 (*Macnab*); Naches, July 30, 1941 (*Brookman*); Seattle, May 9, 1932, May 31, 1934 (*Kincaid*).

Nephrotoma occipitalis (Loew, 1864), var.—2♂♂, Naches River, Mt. Rainier, 1,900 ft., July 31, 1947 (*A*). I am considering these specimens to represent a race or subspecies of the above despite the fact that the praescutal stripes are polished black, instead of reddish brown as in the typical form. The structure of the male hypopygium, especially the somewhat peculiar gonapophyses, confirms this association. It seems probable, moreover, that *snowi* (Doane, 1908) falls in this same group although I do not know the male sex of this latter fly.

Tipula (*Bellardina*) *aspersa* Doane, 1912.—Olympic National Park: Olympic Hot Springs, in skunk cabbage association, August 8, 1947 (*A*). Mt. Rainier: Ashford, August 18, 1940 (*Townes*); Olympia, August 6, 1921.

Tipula (*Bellardina*) *pacifica* Doane, 1912.—Everett, July 6, 1924 (*M*); Keyport, July 1905 (*Doane*); part of type material.

Tipula (*Bellardina*) *rastristyla* Alexander, 1945.—Snoqualmie Pass, June 29, 1924 (*M*); types. Male hypopygium (Fig. 6) generally similar to that of *T.* (*B.*) *sacajawea* Alexander, 1945, but with all details distinct. Ninth tergite, *9t*, with the median region between the sublateral lobes more evidently emarginate; median tubercle conspicuous, low and broad, with at undant setae. Basistyle, *b*, with the most proximal point of the outer lobe a long fingerlike tubercle. Outer dististyle, *od*, narrow, its width across midlength approximately one-fifth the length; setae at apex unusually short and inconspicuous for a member of this group, continued down the inner face of style. Inner dististyle, *id*, narrowed just beyond the base, widely expanded outwardly, the spines large, black and very conspicuous, forming a compact group on the margin at the most expanded portion of the blade, about three of these spines larger and more powerful.

Tipula (*Schummelia*) *subtenuicornis* Doane, 1901.—Mt. Rainier: Longmire Springs, July 20, 1922 (*M*), July 22-24, 1947 (*A*), August 10-13, 1946 (*A*); White River Camp, July 20, 1924 (*M*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Seattle (*Kincaid*); type, June 16, 1920 (*M*); Valleyford, May 17, 1924 (*M*), May 29, 1921 (*M*).

Tipula (*Tipula*) *carinata* Doane, 1901.—Pullman (*Doane*); types.

Tipula (*Yamatotipula*) *albocaudata* Doane, 1901.—Asotin, May 1, 1923 (*M*); Pullman (*Doane*), Wawawai (*Doane*); types.

Tipula (*Yamatotipula*) *cervicula* Doane, 1901.—Mt. Baker: Heather Meadows, 4,000-4,300 ft., August 10-14, 1947, flying low over beds of *Saxifraga, Phyllodoce* and other plants in wet areas (*A*); Kulshan Ridge, 4,500 ft., August 12, 1947 (*A*). Mt. Rainier: Alta Vista, July 29, 1922 (*M*); Eagle Peak, August 25, 1921 (*M*); Mazama Ridge, July 23, 1923 (*M*); Paradise

Park, August 17, 1921 (*M*); Sluiskin, July 28, 1922 (*M*). The types were taken on Rainier in August 1895 by C. V. Piper. A characteristic species of the Hudsonian zone.

Tipula (*Yamatotipula*) *continentalis* Alexander, 1941.—Mt. Baker: Galena Camp, 4,000 ft., August 14, 1947 (*A*). Mt. Rainier: Base of North side, July 26, 1924 (*M*); Longmire Springs, August 23, 1947 (*Remington*).

Tipula (*Yamatotipula*) *cognata* Doane, 1901.—Olympia (*Kincaid*); Seattle (*Doane*); types.

Tipula (*Yamatotipula*) *nuntia* Alexander, 1945.—Lowden, June 22, 1921 (*M*); Naches River, 1,900 ft., July 31, 1947 (*A*); Pullman, July 4, 1922 (*M*); type.

Tipula (*Yamatotipula*) *spernax* Osten Sacken, 1877.—Mt. Rainier: Longmire Springs, June 19, 1917 (*Dyar*). Olympia, April 20, 1894 (*Kincaid*); Manchester, April 14, 1934 (ex *Kincaid*); Moxee, May 24-July 11, 1941 (*Brookman*); Seattle, University of Washington Campus, April 24, 1935 (*Mason*).

Tipula (*Yamatotipula*) *spernax lanei* Alexander, 1940.—Mt. Rainier: University of Washington Collection, without further data; Tipsoo Lake, Chinook Pass, 5,350 ft., July 30, 1947 (*A.*)

Tipula (*Trichotipula*) *dorsolineata* Doane, 1901.—Keyport (*Doane*); Pullman (*Doane*); types.

Tipula (*Trichotipula*) *macrophallus* (Dietz, 1918).—Mt. Rainier: Alder Lake, Elbe, 1,200 ft., August 10, 1946 (*A*), July 24, 1947 (*A*); Texaco Pond, 2,000 ft., July 31, 1947 (*A*). McCleary, August 8, 1921 (*M*); Port Angeles, August 9, 1921 (*M*); Pullman, July 20, 1918, mating pair (*M*); Selah, July 15, 1941 (*Brookman*); Mill Creek, Walla Walla, June 24, 1921 (*M*); Yakima, July 18, 1920 (*M*).

Tipula (*Trichotipula*) *oropezoides* Johnson, 1909.—Walla Walla, August 18, 1923 (*M*). Doubtful record; see discussion earlier under Walla Walla.

Tipula (*Trichotipula*) *repulsa* Alexander, 1943.—Mt. Rainier: Alder Lake, Elbe, 1,200 ft., August 10, 1946 (*A*).

Tipula (*Trichotipula*) *rusticola* Doane, 1912.—Keyport (*Doane*); type; Kelso, June 20, 1935 (*M*); Shelton, Walker's Park, July 21, 1917 (*M*).

Tipula (*Arctotipula*) *illustris* Doane, 1901 (*Prionocera fuscipennis* Loew, 1865).—Ellensburg, August 13, 1944 (*Knowlton*); Moxee, July 11, 1941 (*Brookman*); Seattle, April 14, 1922, April 20, 1931 (*Kincaid*); Yakima, August 13, 1944 (*Knowlton*).

Tipula (Arctotipula) kincaidi sp. nov.—General coloration of head and thorax gray, the praescutum with three more blue-gray stripes; nasus lacking; antennae black throughout; head and much of thorax with very long conspicu-

ous setae, those of the dorsum black, on the coxae white; wings grayish subhyaline, stigma brown, preceded and followed by yellowish areas; veins glabrous; abdominal tergites buffy brown, with a clearer brown central stripe.

♀. Length, about 16 mm.; wing, 19 mm.; antenna, about 3.2 mm.

Frontal prolongation of head light gray, relatively short, about one-half the remainder of head; nasus lacking but with abundant very long black setae at this point; palpi black. Antennae moderately long, black throughout, more or less pruinose, especially the scape; flagellar segments subcylindrical, shorter than the verticils. Head gray, the posterior vertex with a smooth more brownish central area, the remainder of head with long black setae; eyes small, the anterior vertex without tubercle, broad, approximately five times the diameter of scape.

Pronotal scutum light gray, the scutellum clearer blue-gray; scutum with a narrow brown median line and with three groups of long black setae. Mesonotal praescutum light gray, with three more blue-gray stripes, the interspaces with conspicuous black setae; scutum light gray, each lobe with two smooth blue-gray areas; median region and outer part of lobes with conspicuous setae; scutellum gray, with a central brown vitta, the surface with long erect setae; mediotergite gray, clearer behind, both base and apex glabrous, the central part with a patch of erect setae on either side of the midline. Pleura and pleurotergite restrictedly variegated with darker; dorsopleural membrane buffy yellow. Halteres pale. Legs with the coxae light gray, with abundant long pale setae; trochanters gray; femora, tibiae and basitarsi obscure yellow, the tips rather narrowly infuscated; outer tarsal segments more uniformly brownish black. Wings grayish subhyaline; stigma oval, brown, preceded and followed by more yellowed areas; prearcular field broadly pale yellow; veins brown, paler in the brightened areas. Veins glabrous, there being no trichia behind the main stem of *R*. Venation: *Rs* long, approximately three times *m-cu*; R_{1+2} entire, with trichia on the proximal fifth; petiole of cell M_1 about two-thirds *m*; *m-cu* on M_4, the basal section of the latter vertical; cell *2nd A* broad.

Abdominal tergites buffy brown, sparsely pruinose, with a broad clearer brown central stripe that is narrowly interrupted at the posterior border of each segment; sternites pale gray, each with pale brown markings, the central series most distinct; vestiture of basal segments and lateral portions elongate, pale, of the remaining tergites chiefly short and inconspicuous. Ovipositor with the cerci pale, smooth, moderately long, widest on the proximal two-thirds, the tips more narrowed; hypovalvae much shorter, their tips obtuse.

Holotype, ♀, Stillaguamish River, July 15, 1928 (ex *Kincaid*).

I take unusual pleasure in dedicating this fly to Professor Trevor Kincaid, distinguished entomologist, who discovered many novelties in the Tipulidae in the Pacific Northwest described by Coquillett and Doane. In its wing pattern and venation this conspicuous fly suggests species such as *Tipula* (*Arctotipula*) *semidea* Alexander, 1944, and the smaller *T.* (*A.*) *sacra* Alexander, 1944,

both of which have the vestiture of the body short and inconspicuous; *T.* (*A.*) *twogwoteeana* Alexander, 1945, is further distinguished by the patterned wings. All other regional members of the subgenus are more distantly related.

Tipula (*Arctotipula*) *plutonis absaroka* Alexander, 1943.—Mt. Rainier: Without further data, University of Washington; Paradise Valley, 5,600 ft., July 23, 1947 (*A*), swept from beds of *Caltha leptosepala, Dodecatheon viviparum, Potentilla flabellifolia, Phyllodoce empetriformis, Valeriana sitchensis,* and others; Tipsoo Lake, 5,450 ft., July 28-30, 1947 (*A*). Snoqualmie Pass, June 29, 1924 (*M*).

Tipula (*Vestiplex*) *longiventris* Loew, 1863.—Walla Walla, August 18, 1923 (*M*). Doubtful record; see discussion earlier under Walla Walla.

Tipula (Vestiplex) tacomicola sp. nov.—Allied to *longiventris;* antennae (male) relatively long, basal four segments yellow, the outer ones passing into brown; praescutum buffy gray with four stripes that are bordered by dark brown, the intermediate pair almost solidly so; femora yellow, the tips narrowly infuscated; wings relatively long and narrow, patterned with pale yellow, dark brown spots and more extensive paler brown clouds; abdominal tergites obscure yellow, trivittate with brown; male hypopygium with the posterior border of tergite emarginate, the anterior border elevated into a transversely rectangular plate, its posterior border truncated; basistyle small, produced caudad into a strong blackened rod, its tip abruptly narrowed into a spine; inner dististyle a broad flattened plate, the outer apical angle produced into a small black spine.

♂. Length, about 21 mm.; wing, 22.5 mm.; antenna, about 4.4 mm.

Frontal prolongation of head yellow, restrictedly more darkened on sides; nasus distinct; palpi brownish black. Antennae (male) relatively long, as shown by the measurements; scape, pedicel and proximal two flagellar segments yellow, succeeding segments passing into black, the terminal segment pale at tip; flagellar segments rather strongly incised, a little longer than the verticils. Head above pale brown, darker medially, passing into a capillary dark brown vitta on the low vertical tubercle; front, anterior vertex and orbits more yellowed.

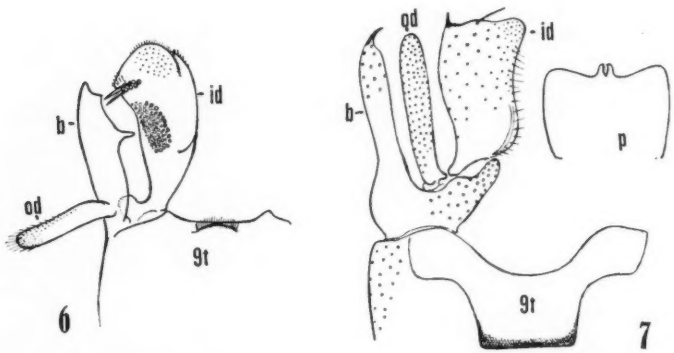
Pronotum brownish gray. Mesonotal praescutum buffy gray, with four stripes, the narrower intermediate pair more uniformly dark brown; lateral stripes dark gray, broadly ringed with dark brown; scutum gray, each lobe with two confluent dark brown rings; scutellum testaceous brown, restrictedly more darkened medially; mediotergite light ashy gray, with a capillary brown central vitta; pleurotergite pale brown, gray pruinose. Pleura chiefly dark gray, especially on the mesepisternum, the dorsal sternopleurite paler; very small to scarcely indicated brown spots on the ventral pteropleurite and beneath the halter. Halteres with stem yellow, knob infuscated. Legs with the coxae gray pruinose; trochanters yellow; femora yellow, the tips narrowly and weakly infuscated; tibiae obscure yellow, the tips even more narrowly darkened; tarsi brown, passing into black; claws unusually small, simple. Wings

relatively long and narrow, pale yellow, variegated with light brown clouds and sparser dark brown spots; the darkest areas include a postarcular mark in the bases of cells *R* and *M;* origin of *Rs;* fork of *Sc;* stigma; anterior cord and in cell *M* at near midlength of vein *Cu;* prearcular and costal fields more uniformly light yellow; outer ends of cells R_5 to *2nd A* paling to yellow at margins; veins brown, more yellowed in the ground areas. Venation: *Rs* nearly twice *m-cu;* R_{1+2} entire; petiole of cell M_1 subequal to *m;* M_{3+4} and basal section of veins M_3 subequal in length.

Abdominal tergites obscure, trivittate with brown, the lateral borders of the segments broadly light buffy gray; outer segments, including hypopygium, more uniformly darkened. Male hypopygium (Fig. 7) with the posterior border of the ninth tergite, *9t,* emarginate, the anterior border elevated into a transversely rectangular plate, its posterior border truncated. Basistyle, *b,* small, produced caudad into a strong blackened rod, its tip abruptly narrowed into a spine. Outer dististyle, *od,* relatively narrow, especially outwardly. Inner dististyle, *id,* a broad flattened plate, the outer apical angle produced into a small black spine, the inner apical region obtusely rounded. Phallosome, *p,* a depressed-flattened yellow plate, the aedeagus jutting only slightly beyond the level of the plate which is presumably composed of the fused gonapophyses.

Holotype, ♂, Longmire Springs, Mt. Rainier, 2,800 ft., found dead in spider's web in building, July 24, 1947, presumably on wing in early July (*C. P. Alexander*).

Among the rather numerous members of the subgenus in the Nearctic fauna, this fly is closest to *Tipula* (*Vestiplex*) *longiventris* Loew, 1863, yet entirely distinct in the hypopygial characters. There are likewise allied species in eastern Asia that are readily separated by genitalic and other characters.



Figs. 6-7.—6. *Tipula* (*Bellardina*) *rastristyla* Alexander, male hypopygium; 7. *Tipula* (*Vestiplex*) *tacomicola* sp. nov., male hypopygium. (Symbols: *b,* basistyle; *id,* inner dististyle; *od,* outer dististyle; *p,* phallosome; *t,* tergite).

Tipula (*Oreomyza*) *alia* Doane, 1911 (*olia* erroneously).—Keyport, July 1905 (*Doane*), Olympia (*Doane*); types. McCleary, August 8, 1921 (*M*); Olympia, August 6, 1921 (*M*); Quilcene, June 24, 1921, July 24, 1917 (*M*); Walla Walla, Mill Creek, June 24, 1921, July 2-6, 1922 (*M*); Yakima, July 18, 1921 (*M*).

Tipula (*Oreomyza*) *appendiculata* Loew, 1863 (*derelicta* Dietz, 1914; *gaspensis* Alexander, 1929; *stalactoides* Doane, 1901).—Valleyford, June 25, 1924 (*M*).

Tipula (*Oreomyza*) *fallax* Loew, 1863.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13, 1947 (*A*). Mt. Rainier: Longmire Springs, August 23, 1947 (*Remington*). Keyport, August 1905 (*Doane*).

Tipula (*Oreomyza*) *rohweri* Doane, 1911.—Selah, Yakima Valley, July 15, 1941 (*Brookman*).

Tipula (*Oreomyza*) *yellowstonensis* Alexander, 1946.—Mt. Rainier: Naches River, 1,900 ft., July 31, 1947 (*A*).

Tipula (*Oreomyza*) *helvocincta* Doane, 1901.—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*), some swept from mountain hemlock; other females found crawling about over the ground, evidently seeking oviposition places; still other specimens found while flying low over dense beds of low chamaephytes, as *Lutkea* and *Phyllodoce*. Mt. Rainier: August 1895 (*C. V. Piper*); types; Alta Vista, July 27, 1922 (*M*); Paradise Park, August 1921 (*M*); Sluiskin, July 28, 1932 (*M*); Tipsoo Lake, July 28-30, 1947 (*A*); Yakima Park, 6,200 ft., August 3, 1947 (*A*). A characteristic species of the Hudsonian zone.

Tipula (*Oreomyza*) *imbellis* Alexander, 1927.—Moxee, Yakima Valley, May 24, 1941 (*Brookman*).

Tipula (*Oreomyza*) *pseudotruncorum* Alexander, 1920.—Mt. Rainier: Longmire Springs, 2,500 ft., July 18, 1919 (*C. L. Fox*), Paradise Valley, 6,000-8,000 ft., August 5, 1919 (*C. L. Fox*); types. Alta Vista, July 22, 1922 (*M*); Nisqually Glacier Trail, 4,200 ft., July 23, 1947 (*A*); Paradise Park, August 1917, 1921 (*M*); Van Trump, July 21, 1922 (*M*); Wonderland Trail, above White River, 5,800 ft., August 1, 1947 (*A*); Yakima Park, July 22, 1924, August 19, 1934 (*M*), altitude 6,500 ft., August 3, 1947 (*M. M. Alexander*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*). Loon Lake, May 16, 1924 (*M*).

Tipula (*Oreomyza*) *shoshone* Alexander, 1946.—Mt. Rainier: Longmire Springs, June 27, 1935 (*M*); Van Trump, July 21, 1922 (*M*). Fort Lewis, May 11, 1946 (*Arnaud*).

Tipula (*Lunatipula*) *aequalis* Doane, 1901.—Mt. Rainier: Longmire Springs, 2,800 ft., July 24, 1947 (*A*). Keyport (*Doane*), Olympia (*Kincaid*), Pullman (*Doane*), Seattle (*Kincaid*), Tokeland (*Doane*); type material.

Tipula (*Lunatipula*) *aitkeniana* Alexander, 1944.—Wawawai, May 20, 1911 (*M*).

Tipula (*Lunatipula*) *albofascia* Doane, 1901.—Almota, without further data (*M*). Very close to *biarmata* Doane, 1912.

Tipula (*Lunatipula*) *armata* Doane, 1901 (*varia* Doane, 1901).—Seattle (*Kincaid*), types of *armata;* Olympia (*Kincaid*), types of *varia.* Canyon Creek, July 26, 1925 (*M*); Pullman, Saints Rest, June 11, 1921 (*M*).

Tipula (*Lunatipula*) *biarmata* Doane, 1912.—Keyport (*Doane*); type.

Tipula (*Lunatipula*) *bisetosa* Doane, 1901.—Pullman (*Doane*), types; July 3, 1921 (*M*); Olympia, August 6, 1921 (*M*); South Tacoma, July 27, 1921 (*M*).

Tipula (*Lunatipula*) *calcarata* Doane, 1901.—Mt. Rainier: August 1895 (*C. V. Piper*), type; Ararat Mt., August 5, 1922 (*M*); Indian Henry, August 2-6, 1922 (*M*); Paradise Park, August 1917, 1922 (*M*); Wonderland Trail, above White River Camp, 5,800 ft., August 1, 1947 (*A*); Yakima Park, 6,400 ft., July 22, 1924 (*M*), July 29, 1947 (*A*); 1 ♂, probably from Paradise Valley, 6,500 ft., July 22, 1940 (*Townes*). A characteristic species of the Hudsonian zone.

Tipula (*Lunatipula*) *californica* (Doane, 1908).—Vancouver, May 11-27, 1911; University of Utah Collection.

Tipula (*Lunatipula*) *dorsimacula* Walker, 1848 (*angustipennis* Loew, 1863).—Almota, May 20, 1923 (*M*); Asotin Creek, April 22, 1923 (*M*), May 11, 1924 (*M*); Clarkston, April 8, 1923 (*Ivar Melander*); Lind, April 5, 1919 (*M*); Pullman, June 4, 1922 (*M*); Wenatchee, May 4, 1919 (*M*).

Tipula (*Lunatipula*) *fulvinoda* Doane, 1912.—Grand Coulee, Foster Coulee, June 24, 1902 (*Doane*); type. To my knowledge no further specimens have been discovered. The following supplementary notes on the type are supplied. No squamal setae, hence its position in the subgenus *Lunatipula* Edwards may be questioned. Male hypopygium (Fig. 8), as seen from the dry type. Ninth tergite, *9t*, large, the two lobes yellow, separated by a deep and narrow median notch; lobes glabrous, truncated at apex, the extreme tip a trifle decurved. Ninth sternite, with the appendage, *9s*, pale and bulbous, at apex with a dense grouping of golden setae. Outer dististyle, *od*, long and slender, subcylindrical; outer surface with a few strong black setae, these becoming smaller outwardly. Inner dististyle, *id*, excluding its outer basal lobe, appearing as a broadly rounded blade. Eighth sternite, *8s*, sheathing, the lateral lobes a trifle produced, bearing a long brush of yellow roughened setae that are decussate across the midline.

Tipula (*Lunatipula*) *impudica* Doane, 1901.—Asotin, May 16, 1923 (*M*); Asotin Creek, April 27, 1922, May 11, 1924 (*M*); Almota (*Doane*), type material; Lind, April 5, 1919 (*M*); Pullman (*Doane*), type material;

Snake River, opposite Clarkston, May 3, 1925 (*M*); Wawawai, May 7, 1898 (*Doane*), type material; May 15, 1921 (*M*), May 28, 1922 (*M*).

Tipula (*Lunatipula*) *incisa incisa* Doane, 1901 (*flavicoma* Doane, 1912). —Pullman (*Doane*); Wawawai (*Doane*); types. Kennewick, May 20, 1921 (*M*); Snake River, at Grand Ronde River, May 9, 1925 (*M*), opposite Clarkston, May 20, 1921 (*M*).

Tipula (*Lunatipula*) *lamellata* Doane, 1901 (*rangiferina* Alexander, 1915).—Pullman (*Doane*), types; July 3, 1921 (*M*); Holland, July 3, 1919 (*M*); Mica, July 14, 1918 (*M*); Wawawai, July 7, 1921 (*M*).

Tipula (*Lunatipula*) *lucida* Doane, 1901.—Lake Chelan, Lucerne, July 29, 1919 (*M*).

Tipula (*Lunatipula*) *macnabi* Alexander, 1929.—Mt. Rainier: La Wis Wis, Columbia National Forest, 1,300 ft., August 2, 1947 (*A*).

Tipula (*Lunatipula*) *macrolabis* Loew, 1864 (*spectabilis* Doane, 1901).— Diamond Lake, June 15, 1924 (*M*).

Tipula (*Lunatipula*) *megalabiata* Alexander, 1915.—Mt. Rainier: Longmire Springs, July 24, 1947 (*A*); Dutch's Creek, Elbe, July 24, 1947 (*A*).

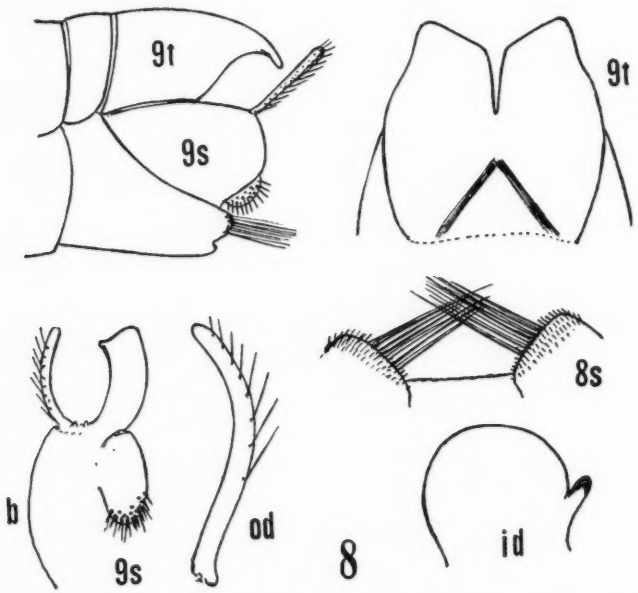


Fig. 8.—*Tipula* (*Lunatipula*) *fulvinoda* Doane, male hypopygium. (Symbols: *b*, basistyle; *id*, inner dististyle; *od*, outer dististyle; *s*, sternite; *t*, tergite).

Big-4 Mountain, July 5, 1924 (*M*); Lake Chelan, Stehekin, July 30, 1919 (*M*); Merritt, July 1942 (*J. S. Dolley*).

Tipula (*Lunatipula*) *olympia* Doane, 1912 (*concinna* Doane, 1901; *flavomarginata* Doane, 1912).—Olympia, May 22, 1894 (*Kincaid*); type.

Tipula (*Lunatipula*) *pellucida* Doane, 1912 (*clara* Doane, 1901; *pyramis* Doane, 1912).—Pullman (*Doane*); Wawawai (*Doane*), types. Almota, May 20, 1923 (*M*); Columbia River, May 1, 1919 (*M*); Wenatchee, April 1918, May 4, 1919 (*M*).

Tipula (*Lunatipula*) *praecisa* Loew, 1872.—Fort Lewis, May 11, 1946 (*Arnaud*).

Tipula (*Lunatipula*) *pubera* Loew, 1864.—Keyport, July 1905 (*Doane*); Seattle, June 1-3 (*Kincaid*).

Tipula (*Lunatipula*) *rainiericola* Alexander, 1946.—Mt. Rainier: Berkeley Park, August 23-27, 1934 (*M*), types.

Tipula (*Lunatipula*) *retusa* Doane, 1901.—Olympia (*Doane*), Pullman (*Doane*), Seattle (*Kincaid*), Wawawai (*Doane*), types. Almota, May 20, 1923 (*M*); Pullman, Lyle Grove, May 20, 1922, June 4, 1922 (*M*); Saints Rest, June 3-4, 1922 (*M*); Valleyford, May 17, 1924 (*M*); Vancouver, May 11, 1911, University of Utah Collection; Walla Walla, Mill Creek, June 24, 1921 (*M*); Wawawai, May 28, 1922 (*M*).

Tipula (*Lunatipula*) *snoqualmiensis* Alexander, 1945.—Lake Keechelus, near Snoqualmie Pass, June 29, 1924 (*M*), types. The male hypopygium (Fig. 9) had not been figured. Suture between ninth tergite, *9t*, and ninth sternite, *9s*, complete; basistyle, *b*, broadly suboval in outline, separated from the sternite by a pale ventral suture that is about one-third complete. Ninth tergite, *9t*, large, deeply notched medially, the lateral lobes produced into long, somewhat flattened arms, broad basally, the outer half more narrowed, the tip subacute; outer surface of lobes with coarse black setae, these much shorter and pale yellow at tips and likewise becoming very small nearer the midline; at base of notch a conspicuous compressed median tooth that is directed caudad and slightly dorsad. Ninth sternite, *9s*, wth the appendage small but extensive, each further produced at its lower mesal angle into a smaller globular lobule, both lobes provided with conspicuous setae. Basistyle, *b*, truncate at apex. Outer dististyle small, placed at base of the inner style; longest setae a little more than one-half the total length of the style. Inner dististyle, *id*, with both the beak and the subapical beak very heavily blackened; dorsal crest undeveloped; outer basal lobe attached to main body of style by a narrow basal union only, appearing as a broadly flattened yellow blade, narrowed at apex into a flattened obtuse beak; surface corrugated longitudinally and provided with abundant pale setae. Phallosome, *p*, forming a common sclerotized base, with the gonapophyses, *g*, appearing as divergent paddle-shaped blades near the apex, these arms much longer than the small capitate apical projection that includes the minute aedeagus. Eighth sternite, *8s*, only moderately sheath-

ing, its base telescoped beneath the seventh sternite, the apex terminating about one-fourth the length of the subcylindrical ninth sternite; apex of sternite shallowly notched, the median area with numerous long straight setae; outer portion of the very low oblique lobes with about four more powerful flattened bristles that bend inward, their tips decussate at the midline.

Tipula (*Lunatipula*) *splendens* Doane, 1901.—Olympia, May 23, 1897 (*Kincaid*); type.

Tipula (*Lunatipula*) *sylvicola* Doane, 1912.—Keyport, July 1905 (*Doane*); type.

Tipula (*Lunatipula*) *unicincta* Doane, 1901.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 14, 1947 (*A*). Mt. Rainier: Longmire Springs, August 10-13, 1946 (*A*); Summerland Trail, July 24, 1924 (*M*). Keyport (*Doane*), Pullman (*Doane*), types; Mt. Adams, July 24, 1921 (*M*); Orcas Island, Cascade Lake, August 17, 1925 (*M*).

Tipula (*Lunatipula*) *usitata* Doane, 1901.—Quinault Lake, in cedar-hemlock association, July 12, 1945 (*Shelford*); Tokeland (*Doane*); type ♀.

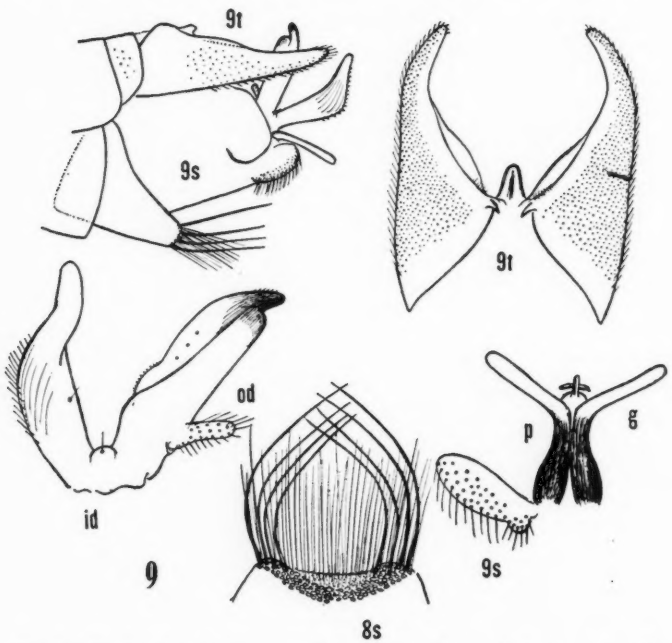


Fig. 9.—*Tipula* (*Lunatipula*) *snoqualmiensis* Alexander, male hypopygium. (Symbols: *d*, dististyle; *g*, gonapophysis; *p*, phallosome; *s*, sternite; *t*, tergite).

Tipula (*Lunatipula*) *vittatipennis* Doane, 1912 (*albovittata* Doane, 1901).—Pullman (*C. V. Piper*); type.

Tipula (*Hesperotipula*) *fragmentata* Dietz, 1919.—Ilwaco, July 12, 1922 (*M*).

Tipula (*Hesperotipula*) *streptocera* Doane, 1901.—Olympia (*Doane*), Tokeland (*Doane*); types. Carson, Wind River Experimental Forest, in 30-year broadleaf forest, July 10, 1945 (*Shelford*); Keyport, July 1905 (*Doane*).

Tipula (*Hesperotipula*) *streptocera pallidocera* Dietz, 1919.—Keyport, July 1905 (*Doane*); type. Presumed to be a teneral *streptocera*.

Tipula optiva Alexander, 1921 (subgenus uncertain).—North Bend, July 9, 1920 (*E. P. Van Duzee*); type. Belongs to the so-called *juncea* group; in an earlier paper (Philippine Journ. Sci., 57: 122; 1935) I had referred this group to the subgenus *Oreomyza* Pokorny but now prefer to leave the position unsettled for the time being.

CYLINDROTOMINAE

Cylindrotoma splendens Doane, 1901 (*juncta* Coquillett, 1901).— Mt. Rainier: Cayuse Pass, 4,650 ft., August 1, 1947 (*M. M. Alexander*); Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*M. M. Alexander*); Wonderland Trail, above White River, 4,900-5,000 ft., August 1, 1947 (*A*). Ilwaco, May 5, 1918 (*M*). These specimens seem to be referrable to the race *pallescens* Alexander, 1930, distinguished by the unusually pale coloration.

Phalacrocera occidentalis Alexander, 1927.—Mt. Rainier: Longmire Springs, 2,800 ft., June 10; type.

LIMONIINAE

LIMONIINI

Limonia (*Limonia*) *bistigma* (Coquillett, 1905) (as *bestigma; tributaria* Alexander, 1943).—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*); Nooksack River, August 11, 1925 (*M*); Skyline Trail, August 10, 1925 (*M*). Mt. Rainier: Ashford, July 11, 1940 (*Townes*); Elbe, July 13, 1940 (*Townes*); Hansen Camp, July 31, 1922 (*M*); Longmire Springs, July 22, 1947, August 10, 1946 (*A*); Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*). Olympic National Park: Olympic Hot Springs, 2,200 ft., August 7, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Brinnon, Forest Reserve, July 27, 1917 (*M*); Ilwaco, July 1917, August 23, 1917 (*M*); Lake Crescent, July 26, 1917 (*M*); Pluvius, July 16, 1922 (*M*); Puget, July 4, 1925 (*M*); Quilcene, July 24, 1917, August 11, 1921 (*M*); Tulalip, August 3, 1917 (*M*); Yukon Camp, Grotto, August 15, 1944 (*Knowlton*).

Limonia (*Limonia*) *sciophila* (Osten Sacken, 1877).—Mt. Baker: Galena Camp, 4,000 ft., August 10-12, 1947 (*A*), Silver Fir Camp, 1,990 ft., August 15, 1947 (*A*). Olympic National Park: Deer Park, 5,400 ft., August

6, 1947 (*A*). Mt. Rainier: Longmire Springs, June 27, 1935, July 20, 1922 (*M*), July 22, 1947, August 10-13, 1946 (*A*); White River, August 28, 1934 (*M*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Barnes State Reservation, September 27, 1946 (*Fender*); Big-4 Mountain, July 5, 1924 (*M*); Blaine, August 7, 1917 (*M*); Cascade Lake, Orcas Island, August 18, 1925 (*M*); Castle Rock, August 28, 1921 (*M*); East Port Orchard, September 22-26, 1946 (*Fender*); Everett, June 19, 1920 (*M*); Ilwaco, May 5, 1918, July 12, 1922, August 27, 1917 (*M*); Kachess Lake, August 13, 1946 (*A*); Lake Crescent, Piedmont, July 26, 1917 (*M*); Lewis & Clark State Park, September 28, 1946 (*Fender*); Olympia, June 22, 1920, August 6, 1921 (*M*); Pluvius, July 10, 1917 (*M*); Potlatch, Hood Canal, July 28, 1917 (*M*); Quilcene, July 24, 1917 (*M*); Shelton, Walkers Park, July 21, 1917 (*M*); Toledo, August 28, 1921 (*M*); Tulalip, August 3, 1917 (*M*).

Limonia (*Metalimnobia*) *californica* (Osten Sacken, 1861).—Mt. Rainier: Alder Lake, Elbe, 1,200 ft., August 10, 1946 (*A*). Seattle, May 5, 1901 (*Kincaid*).

Limonia (*Metalimnobia*) *cinctipes* (Say, 1823).—Recorded by Williston, 1893, from Washington, possibly in error.

Limonia infuscata (Doane, 1900) (*adjecta* Doane, 1908; *nitidiuscula* Alexander, 1927).—Mt. Baker: Bagley Creek Camp, 2,500 ft., August 13, 1947 (*A*); Silver Fir Camp, 1,990 ft., August 13, 1947 (*A*). Olympic National Park: Olympic Hot Springs, 2,200 ft., August 4-5, 1947 (*A*). Mt. Rainier: Longmire Springs, August 26, 1921 (*M*); Ohanapecosh Hot Springs, July 25, 1947 (*A*); Wonderland Trail, above White River, 5,300 ft., August 1, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Cascade Lake, Orcas Island, August 17, 1925 (*M*); East Port Orchard, September 22-26, 1946 (*Fender*); Lewis & Clark State Park, September 28, 1946 (*Fender*); Olympia, August 6, 1921 (*M*); Twanoh State Park, September 22, 1946 (*Fender*).

Limonia simulans concinna (Williston, 1893).—Asotin, May 16, 1923 (*M*); Lilliwaup, July 23, 1917 (*M*).

Limonia venusta (Bergroth, 1888) (*duplicata* Doane, 1900; *negligens* Alexander, 1927).—Mt. Baker: Galena Ski Club, below Heather Meadows, 3,800 ft., August 12, 1947 (*A*). Olympic National Park: Olympic Hot Springs, 2,000 ft., August 7, 1947 (*A*); Boulder Lake Trail, 3,500 ft., August 5, 1947 (*A*). Mt. Rainier: Paradise Park, July 27, 1922 (*M*). Keyport (*Doane*); Pullman, May, July 11, 1898 (*Doane*); Selah, July 26, 1941 (*Brookman*); Tokeland, 1899 (*Doane*), type of *duplicata;* Wawawai, April 9 (*Doane*).

Limonia (*Geranomyia*) *canadensis* (Westwood, 1835).—Mt. Rainier: Ohanapecosh Hot Springs, 1,900 ft., July 28-30, 1947 (*A*). Zillah, Yakima Valley, August 17, 1941 (*Brookman*).

Limonia (*Dicranomyia*) *acerba* Alexander, 1943.—Mt. Rainier: Altitude

5,700 ft., July 8, 1940 (*Townes*), type; Paradise Valley, 5,600 ft., July 23, 1947 (*A*), swept from beds of *Erythronium montanum, Phyllodoce empetriformis, Valeriana sitchense,* and others; further material from same place, August 11, 1946 (*A*); Yakima Park, 6,400 ft., July 27, 1947 (*A*). Characteristic of the Hudsonian zone.

Limonia (*Dicranomyia*) *anteapicalis* Alexander, 1946.—Moxee, Yakima Valley, May 24-July 15, 1941 (*Brookman*); types.

Limonia (*Dicranomyia*) *athabascae* (Alexander, 1927).—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13-15, 1947 (*A*). Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Elbe, 1,200 ft., August 10-13, 1946 (*A*); Longmire Springs, 2,800 ft., August 23, 1947 (*Remington*); Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*). Mt. St. Helens: Toutle River, near Spirit Lake, 3,000 ft., July 20, 1947 (*A*). Ilwaco, May 5, 1918 (*M*).

Limonia (*Dicranomyia*) *brevivena* (Osten Sacken, 1869).—Mt. Rainier: Alder Lake, near Elbe, August 12, 1946 (*A*); Naches River, 1,900 ft., July 31, 1947 (*A*). Moxee, June 11, 1941 (*Brookman*).

Limonia (*Dicranomyia*) *citrina* (Doane, 1900).—Rose Spring, Blue Mts., July 19, 1921 (*M*); Union Flat, May 14, 1922 (*M*); Wawawai, April 24, 1897 (*Doane*), type ♀.

Limonia (*Dicranomyia*) *fulva* (Doane, 1900).—Mt. Rainier: Longmire Springs, 2,800 ft., July 22, 1947 (*A*). Pullman, May 13, 1898 (*Doane*), type.

Limonia (*Dicranomyia*) *gracilis* (Doane, 1900).—Olympic National Park: Olympic Hot Springs, 2,200 ft., August 5-7, 1947, in skunk cabbage association (*A*).

Limonia (*Dicranomyia*) *halterata* (Osten Sacken, 1869) (*cinereipennis* Lundstrom, 1912).—Mt. Baker: Galena Camp, 4,000 ft., August 9-10, 1947 (*A*); Nooksack River, August 11, 1925 (*M*). Olympic National Park: Olympic Hot Springs, August 4-6, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 26, 1921 (*M*), August 10-13, 1946 (*A*), July 22, 1947 (*A*); Ohanapecosh Hot Springs, July 25, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Adna, July 10, 1917 (*M*); East Port Orchard, September 23-26, 1946 (*Fender*); Everett, June 19, 1920 (*M*); Ilwaco, May 5, 1918, July 12, 1922 (*M*); Keyport, (*Doane*); Montesano, July 19, 1917 (*M*); Shelton, Walker's Park, July 21, 1917 (*M*).

Limonia (*Dicranomyia*) *humidicola* (Osten Sacken, 1859).—Mt. Rainier: Elbe, 1,200 ft., July 24, 1947 (*A*); Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*); Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*). East Port Orchard, September 23-26, 1946 (*Fender*); Tacoma, July 9, 1944 (*Arnaud*).

Limonia (*Dicranomyia*) *illustris* Alexander, 1944.—Ilwaco, May 5, 1918 (*M*).

Limonia (*Dicranomyia*) *longipennis* (Schummel, 1829) (*immemor* Osten Sacken, 1861).—Ellensburg, August 3, 1944 (*Knowlton*); Lowden, June 22, 1921 (*M*).

Limonia (*Dicranomyia*) *marmorata* (Osten Sacken, 1861) (*signipennis* Coquillett, 1905).—Keyport (*Doane*); Shelton, Walker's Park, July 21, 1917 (*M*).

Limonia (*Dicranomyia*) *particeps* (Doane, 1908).—Mt. Rainier: Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*). East Port Orchard, September 23-26, 1946 (*Fender*); Keyport, (*Doane*), types.

Limonia (*Dicranomyia*) *penicillata* (Alexander, 1927).—Lake Colville, near Sprague, 1,900 ft., August 14, 1946 (*A*).

Limonia (*Dicranomyia*) *stigmata* (Doane, 1900).—Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946 (*A*). Keyport (*Doane*).

Limonia (*Dicranomyia*) *vulgata* (Bergroth, 1888) (*ochracea* Doane, 1900).—Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Everett, June 19, 1920, July 11, 1924 (*M*); 5-Mile Lake, July 9, 1925 (*M*); Ilwaco, June 28, 1925 (*M*); Keyport, (*Doane*); La Center, July 8, 1917 (*M*): Lake Crescent, Piedmont, July 26, 1917 (*M*); Montesano, July 19, 1917 (*M*); Pluvius, July 10, 1917 (*M*).

Limonia (*Discobola*) *elegans* (Doane, 1900).—Olympic National Park: Olympic Hot Springs, August 4-6, 1947, skunk cabbage association (*A*). Mt. Rainier: Longmire Springs, 2,500 ft., August 13, 1946 (*A*); 2,800 ft., July 22, 1947 (*A*); Ohanapecosh Hot Springs, July 25, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Lake Chelan, Lucerne, July 29, 1919 (*M*), a female specimen lacking the supernumerary crossvein in both wings; Olympia, June 22, 1920 (*M*); Seattle, May 1942 (*E. I. Smith*, in U.S. National Museum); Shelton, Walker's Park, July 21, 1917 (*M*); Tacoma, July 9, 1944 (*Arnaud*); Tokeland, 1899 (*Doane*), type.

Antocha (*Antocha*) *monticola* Alexander, 1917.—Mt. Rainier: La Wis Wis, Columbia National Forest, 1,300 ft., August 2, 1947 (*A*). Selah, Yakima Valley, July 15, 1941 (*Brookman*); Union Gap, June 24, 1941 (*Brookman*); Walla Walla, Mill Creek, July 2-6, 1922 (*M*).

Elliptera astigmatica Alexander, 1912.—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*), commonly associated with *Phyllolabis fenderiana*. Olympic National Park: Boulder Lake Trail, 2,300-4,000 ft., August 5, 1947 (*A*). Mt. Rainier: Cayuse Pass, 4,600 ft., July 30, 1947 (*A*); Christine Falls, 3,665 ft., on wet cliffs, July 23, 1947 (*A*); Hansen Camp, July 31, 1922 (*M*); Longmire Springs, July 22, 1947, August 10, 1946 (*A*); Paradise Valley, August 1917 (*M*), July 23, 1947, August 11, 1946 (*A*); Tipsoo Lake, July 28-30, 1947 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*). Lake Chelan, Lucerne, July 29, 1919 (*M*); Snoqualmie, July 1, 1933 (ex *Kincaid*).

Dicranoptycha stenophallus Alexander, 1949.—Mt. Rainier: Longmire Springs, 2,800 ft., July 22, 1947 (*A*). Ilwaco, July 1917 (*M*); Lewis & Clark State Park, August 20, 1944 (*Knowlton*); Olympia, July 28, 1917 (*M*); Pullman, Saints Rest, June 11, 1921 (*M*); Seattle, June 16, 1920 (*M*); Walla Walla, Mill Creek, July 26, 1922 (*M*).

Dicranoptycha nigrogenualis sp. nov.—General coloration gray, the praescutum with indications of three faintly indicated more brownish stripes; halteres whitened; legs with all coxae yellow; femora yellow, the tips conspicuously blackened, the tibial bases more narrowly darkened; wings brownish yellow, veins brown, except in the brighter costal field; male hypopygium with the outer dististyle relatively slender, its apical spine of moderate length only, the outer half with small appressed spines; inner dististyle darkened, the apex dilated, subtruncate, with about three unusually strong yellow setae.

♂. Length, about 10.5 mm.; wing, 10 mm.

♀. Length, about 11 mm.; wing, 11 mm.

Rostrum dark gray; palpi black. Antennae with the scape dark brown; pedicel obscure yellow; flagellum dark brown, the proximal two or three segments a little brightened; flagellar segments nearly cylindrical, the outer ones elongate; verticils longer than the segments. Head gray.

Thorax gray, the praescutum with indications of three faintly indicated more brownish stripes, the scutal lobes similarly darkened. Pleura uniformly clear light gray, including the dorsopleural region. Halteres whitened. Legs with all coxae yellow, the fore pair very narrowly and indistinctly more darkened at bases; trochanters yellow, the tips conspicuously blackened, the fore pair slightly more extensively so; tibiae yellow, the bases and tips narrowly blackened; basitarsi obscure brownish yellow, passing into dark brown; outer tarsal segments black. Wings brownish yellow, the prearcular and costal fields clearer yellow; veins dark brown, yellow in the brightened fields. Venation: *Rs* a little longer than cell *1st* M_2 and somewhat less than twice the basal section of R_{4+5}; cell *1st* M_2 shorter than any of the cells beyond it; *m-cu* more than one-half its length beyond the fork of *M*.

Abdomen black, sparsely pruinose; hypopygium black. Male hypopygium (Fig. 10) with the tergal arms, *9t*, relatively slender, the tip directed laterad into a slender spine, the outer margin with a low flange. Outer dististyle relatively slender, its apical spine moderately long; surface of outer two-fifths with relatively small appressed spines; basal half of outer surface with delicate setulae. Inner dististyle with basal half stout, the outer portion more narrowed, the apex a trifle dilated, subtruncate at tip and here with three or four unusually strong yellow setae.

Holotype, ♂, Boulder Lake Trail from Olympic Hot Springs, Olympic National Park, altitude 3,400 ft., August 5, 1947 (*M. M. Alexander*). Allotype, ♀, Sahale Falls, Mt. Hood, Oregon, altitude 4,575 ft., July 17, 1947 (*C. P. Alexander*).

The present fly is closest to *Dicranoptycha occidentalis* Alexander, 1927,

and *D. quadrivittata* Alexander, 1919, from which it differs in the coloration of the body and legs and in the structure of the male hypopygium.

PEDICIINI

Ula (*Ula*) *paupera* Osten Sacken, 1869.—Olympic National Park: Olympic Hot Springs, 2,200-2,500 ft., August 4-5, 1947 (*A*).

Pedicia (*Pedicia*) *parvicellula* Alexander, 1938.—Washington State, *H. K. Morrison;* Bigot Collection. Mt. Baker: Galena Camp, 4,000 ft., August 11-14, 1947 (*A*), swept from mountain hemlock. Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946 (*A*), a single male, going through all the motions of swarming, flying in great graceful loops; 4,700 ft., August 13, 1940 (*Townes*). Twanoh State Park, September 22, 1946 (*Fender*).

Ornithodes harrimani Coquillett, 1900.—Mt. Rainier: Longmire Springs, 2,800 ft., August 23, 1947, at light (*Remington*).

Pedicia (*Tricyphona*) *ampla* (Doane, 1900).—Seattle (*Piper*), type. Orcas Island, above Mountain Lake, August 18, 1925 (*M*).

Pedicia (*Tricyphona*) *aperta* (Coquillett, 1905).—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946 (*A*), August 23, 1947, at light (*Remington*). Mt. St. Helens: Toutle River, near Spirit Lake, 3,000 ft., July 20, 1947 (*A*); Timberline, 4,500 ft., July 21, 1947 (*A*). East Port Orchard, September 26, 1946 (*Fender*); Glenwood Road, Klickitat River, July 23, 1921 (*M*). Venation (Fig. 11).

Pedicia (*Tricyphona*) *bicomata* Alexander, 1943.—Mt. Rainier: Longmire

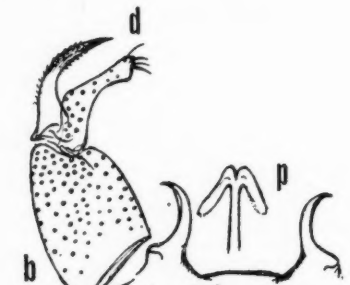


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Fig. 10.—*Dicranoptycha nigrogenualis* sp. nov., male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *p*, phallosome; *t*, tergite).

Springs, 2,800 ft., August 10, 1946 (*A*), June 27, 1935 (*M*); Texaco Pond, 2,000 ft., July 31, 1947 (*A*); Wonderland Trail, above White River, 4,800 ft., August 1, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). East Port Orchard, September 23-26, 1946 (*Fender*); Ilwaco, July 1917 (*M*); Lewis & Clark State Park, September 28, 1946 (*Fender*); Twanoh State Park, September 22, 1946 (*Fender*).

Pedicia (*Tricyphona*) *constans* (Doane, 1900).—Olympia, May 6, 1894 (*Kincaid*); Seattle, May 10, 1897 (*Kincaid*), types. Olympic National Park: Olympic Hot Springs, August 7, 1947 (*A*). Mt. Rainier: Longmire Springs, June 19, 1917 (*Dyar*), August 10, 1946 (*A*). East Port Orchard, September 23-26, 1946 (*Fender*); Everett, July 6, 1924 (*M*); Selah, Yakima Valley, July 15, 1941 (*Brookman*).

Pedicia (*Tricyphona*) *degenerata* (Alexander, 1917).—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*), common, including one fully-winged male. Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*), swept from beds of *Claytonia*, sp.; Wonderland Trail, above White River, 5,700 ft., August 1, 1947 (*A*). High Canadian or low Hudsonian zone.

Pedicia (*Tricyphona*) *diaphana* (Doane, 1900).—Olympia, March 16, 1896 (*Kincaid*); Pullman, May 4, 1898 (*Doane*); Seattle (*Kincaid*), types. Mt. Baker: Galena Camp, 4,000 ft., August 13, 1947 (*A*), darker than normal, especially the wings, which approach the condition in the closely allied *exoloma*. Mt. Rainier: Longmire Springs, 2,800 ft., June 19, 1917 (*Dyar*). Venation (Fig. 12).

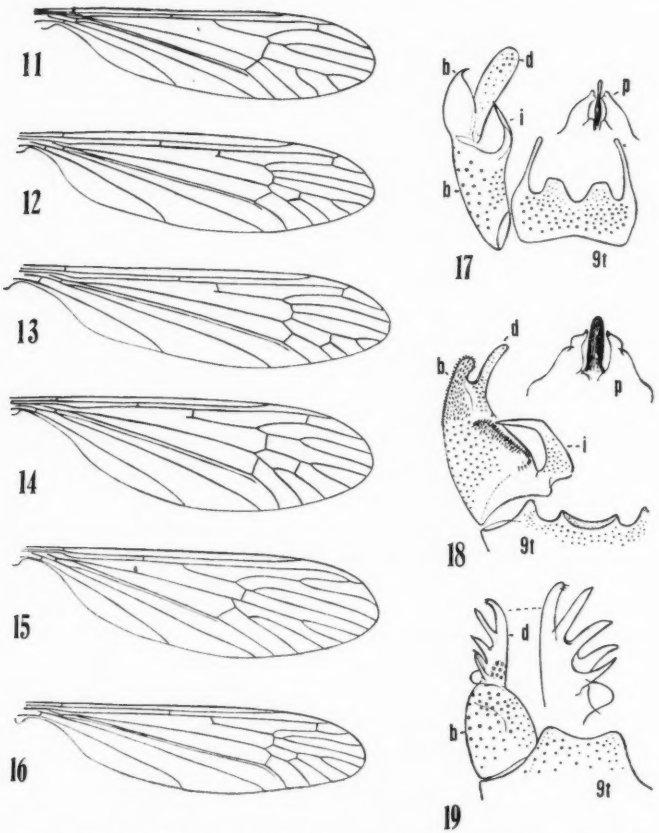
Pedicia (*Tricyphona*) *exoloma* (Doane, 1900).—Pullman, April 20, 1897 (*Doane*), types. Venation (Fig. 13).

Pedicia (*Tricyphona*) *glacialis* (Alexander, 1917).—East Port Orchard, September 23-26, 1946 (*Fender*); Hoodsport, September 22, 1946 (*Fender*); Lewis & Clark State Park, September 28, 1946 (*Fender*); Twanoh State Park, September 22, 1946 (*Fender*). Venation (Fig. 14).

Pedicia (*Tricyphona*) *protea* (Alexander, 1918).—Mt. Rainier, without exact data, type. Mt. Baker: Above Galena Camp, 4,100 ft., August 13, 1947 (*A*). Olympic National Park: Boulder Lake Trail, along mountain stream, 3,500 ft., August 5, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., June 19, 1917 (*Dyar*), August 23, 1947, at light (*Remington*); Van Trump, July 21, 1922 (*M*); Wonderland Trail, above White River, 4,600-5,500 ft., August 1, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*). Barnes State Reservation, September 27, 1946 (*Fender*); East Port Orchard, September 23-26, 1946 (*Fender*); Ilwaco, May 5, 1918 (*M*); Lewis & Clark State Park, September 28, 1946 (*Fender*).

One of the most remarkable crane-flies ever discovered. It furnished the explanation of various disputed points concerning the wing venation, particularly of the radial field, with the result of changing the interpretation of the veins not merely in the Tipulidae but, by homology and phylogeny, through-

out the entire order Diptera. I have figured the wing in various earlier papers and have added it here in order to make it more readily available (Fig. 15). The male hypopygium (Fig. 17) has the tergite, *9t*, transverse, its caudal border with a flattened lobe on either side of the broad central emargination, the apex of the lobe truncated or nearly so; lateral tergal arms produced caudad as slender rods, their outer ends a trifle more expanded. Basistyle, *b*,



Figs. 11-19.—11. *Pedicia* (*Tricyphona*) *aperta* Coquillett, venation; 12. *Pedicia* (*Tricyphona*) *diaphana* Doane, venation; 13. *Pedicia* (*Tricyphona*) *exoloma* Doane, venation; 14. *Pedicia* (*Tricyphona*) *glacialis* Alexander, venation; 15. *Pedicia* (*Tricyphona*) *protea* Alexander, venation; 16. *Pedicia* (*Tricyphona*) *rainieria* Alexander, venation; 17. *Pedicia* (*Tricyphona*) *protea* Alexander, male hypopygium; 18. *Pedicia* (*Tricyphona*) *rainieria* Alexander, male hypopygium; 19. *Pedicia* (*Tricyphona*) *smithae* Alexander, male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *i*, interbase; *p*, phallosome; *t*, tergite).

with its apex narrowed into a flattened pale blade, the tip of which is further narrowed into a sharp spine; interbase, *i*, a broad-based rod, narrowed into a slightly twisted slender blade, its tip acute. Dististyle, *d*, single, appearing as a flattened pale blade that is slightly longer than the lobe of the basistyle, the apex obtuse; surface of dististyle with scattered pale setae, some of the outer ones stouter but pale. Phallosome, *p*, small and compact, as usual in the tribe Pediciini; aedeagus slender, weak. It should be emphasized that there are no blackened spinous pegs on either the basistyle or dististyle, a common condition elsewhere in the tribe.

Pedicia (*Tricyphona*) *rainieria* (Alexander, 1924).—Mt. Rainier: Burrough's Mt., August 21, 1934 (*M*); Longmire Springs, June 1917 (*Dyar*), type. Venation (Fig. 16): Among variations, Sc_2 in cases lies much farther distad than shown; *Rs* sometimes long-spurred at origin, in cases with the spur jutting basad to opposite Sc_2; R_{4+5} sometimes even shorter than shown; cell M_1 variable in length, from exceeding its petiole to only two-thirds as long. Male hypopygium (Fig. 18) with the tergite, *9t*, extensive, the median region more produced into a subtruncate central lobe, in cases longer or more protruded than shown. Basistyle, *b*, with apex and the low lateral lobe densely provided with short spinous setae or peglike spines; interbase, *i*, a powerful curved sabre-like blade, narrowed to the acute tip; basal portion with numerous pale setae, long but inconspicuous because of their color. Dististyle, *d*, much smaller than the interbase, appearing as a flattened blade, the tip narrowly obtuse; basal portion of style with scattered tubercles that bear long pale setae; outer half or more of style with scattered microscopic punctures. Phallosome, *p*, with the aedeagus relatively stout, blackened.

Pedicia (*Tricyphona*) *septentrionalis septentrionalis* (Bergroth, 1888) (*sparsipuncta* Alexander, 1920).—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946 (*A*), in small swarms along stream.

Pedicia (*Tricyphona*) *septentrionalis vitripennis* (Doane, 1900).—Olympia, April 11, 1894 (*Kincaid*); Wawawai, April 24, 1897 (*Doane*), types. Wawawai, 2,400 ft., May 28, 1922 (*M*).

Pedicia (*Tricyphona*) *smithae* Alexander, 1941.—Olympic National Park: Boulder Lake Trail, 4,000 ft., August 5, 1947 (*A*). Mt. Rainier: Alta Vista, July 28, 1922 (*M*); Cayuse Pass, 4,300 ft., July 30, 1947 (*A*); Indian Henry, August 6, 1922 (*M*); Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*); Paradise Valley, August 1917 (*M*); 5,500 ft., July 23, 1940 (*Townes*), 5,560 ft., August 11, 1946 (*A*); Summerland, July 24, 1924 (*M*); Wonderland Trail, below Yakima, 5,700-6,000 ft., abundant among the spruce and fir, August 1, 1947 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*). Big-4 Mountain, July 5, 1924 (*M*). A characteristic species of the Hudsonian zone.

The type was from Tipsoo Lake, Chinook Pass, Rainier, taken by Dr.

Marion Estelle Smith, for whom the species was named. The altitude as given at the time of the original description is undoubtedly too low and should be approximately 5,450 ft. The venation (Figs. 20, 21), especially of the radial field, is surprisingly variable. In the three diagrams (Fig. 21), A shows vein R_{2+3+4} present as a short element; B has cell R_4 sessile, with veins R_{2+3}, R_4 and R_5 all arising from a single point at the end of the sector; C shows a short fusion of R_{4+5}. All such types of venation occur and are common in this single species. Male hypopygium (Fig. 19) of the general type of *ampla* but with the details of the tergite, *9t*, and dististyle, *d*, quite distinct from this and other members of the *ampla* group. The dististyle is unusually high and vertical in position, placed at the apex of the basistyle which is without apical lobes; the style bears six lobes or blades, the most basal one being an obtuse blade. Tergite with the apex gently emarginate, without lateral lobules.

I had suspected for some time that the female sex of this fly would prove to be short-winged and flightless, since, while the species is often very abundant, only males could be found. This sex was finally discovered on Mt. St. Helens and proved to be brachypterous, as believed.

♀. Length, about 13 mm.; wing, 5.3 x 1.4 mm.

Characters as in the male, differing in the reduced wings. General coloration, including the antennae, much paler than in the male. Antennae 15-segmented, obscure yellow. Mesonotal praescutum buffy yellow, the stripes poorly indicated, present only on the cephalic part. Legs relatively short and stout, as compared with the male, obscure yellow, the femoral tips not or scarcely darkened. Wings brachypterous, as shown by the measurements. Venation normal, not distorted, merely conforming to the reduced size of the wing.

Allotype, ♀, Mt. Saint Helens, Washington, at timberline, 4,300 ft., July 21, 1947 (*M. M. Alexander*).

Pedicia (Tricyphona) tacoma sp. nov.—Size large (wing, male, 16 mm.); mesonotum gray, the praescutum with four conspicuous brown stripes; wings with the ground grayish yellow, with a conspicuous brown pattern, including seams over the crossveins and marginal spots at ends of the longitudinal veins; petiole of cell R_4 very long, nearly two-thirds the cell; cell *1st* M_2 elongate; abdominal segments conspicuously dimidiate, the basal portion brown, the apex yellow; male hypopygium with the interbase a small darkened club; dististyle terminal in position, provided with several black spinous setae, including one of unusual size on the outer margin.

♂. Length, about 16 mm.; wing, 16 mm.; antenna, about 1.9 mm.

Rostrum brown, gray pruinose; palpi dark brown. Antennae short, 15-segmented, dark brown throughout; basal flagellar segments oval, the outer ones much narrowed, subcylindrical; verticils very long, greatly exceeding the segments. Head dark brownish gray; front paler brown.

Pronotum brownish gray, the scutellum and pretergites obscure yellow.

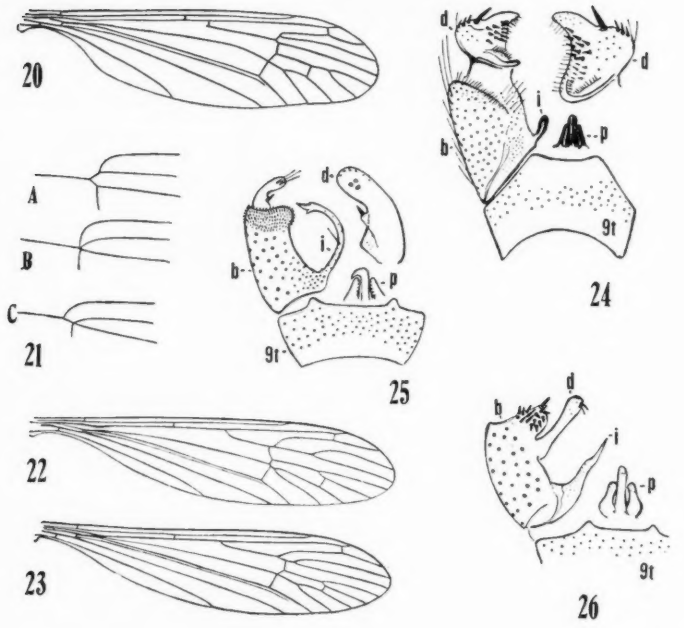
Mesonotal praescutum gray with four conspicuous brown stripes, the intermediate pair separated by a narrow ground line; vestiture of interspaces long, pale; posterior sclerites of notum light gray, the scutal lobes rather indistinctly patterned with brownish gray; posterior portion of mediotergite brown. Pleura gray, the ventral sternopleurite more brownish gray; dorsopleural membrane orange yellow. Halteres yellow. Legs with the coxae yellow, sparsely pruinose; trochanters yellow; a single partial posterior femur remains, this brownish yellow. Wings with the ground grayish yellow, handsomely patterned with brown, as follows: A common major area in bases of cells *R* and *M;* a similarly large subquadrate mark at origin of *Rs,* not reaching vein *M* behind; spots and seams along cord and *m,* fork of *Rs,* all outer forks, and at ends of all longitudinal veins; an additional brown mark near outer end of cell R_4; short supplementary marginal spots in both Anal cells, these surrounding weak vein spurs back from the margin; veins brown, the bullate areas at the cord conspicuous. Venation: Sc_2 lying far basad so Sc_1 is nearly one-half longer than the stem of *Sc* beyond *h;* R_2 transverse, a little shorter than R_{1+2}; *Rs* very long, strongly arcuated at origin which lies just before Sc_2; *r-m* a little shorter than the basal section of R_{4+5}; second section of the latter, or petiole of cell R_4, very long, nearly two-thirds the cell; cell *1st* M_2 elongate; basal section of M_3 about twice the transverse *m; m-cu* at or close to fork of *M;* cord oblique.

Abdominal tergites conspicuously dimidiate, the basal part brown, the somewhat narrower posterior portion obscure yellow; transverse impressed lines of basal rings black, conspicuous; basal tergite gray pruinose; sternites similarly dimidiate but with the basal brown rings paler; outer segments and hypopygium uniformly dark brown. Male hypopygium (Fig. 24) with the tergite, *9t,* narrowed outwardly, the caudal border nearly truncate. Basistyle, *b,* with the interbase, *i,* a small darkened club. Dististyle, *d,* terminal in position, large, armed with strong spinous setae, as shown, one of the latter on outer margin much larger.

Holotype, ♂, Paradise Valley, Mt. Rainier, altitude 5,560 ft., August 11, 1946 (*C. P. Alexander*).

This striking crane-fly is one of the most distinct members of the subgenus so far discovered. From the various species likewise having cell R_4 long-petiolate, including *Pedicia* (*Tricyphona*) *glacialis* (Alexander), the fly differs conspicuously in the heavily patterned wings and in the structure of the male hypopygium. Except for the long-petioled cell R_4 it somewhat more suggests species such as *P.* (*T.*) *auripennis* (Osten Sacken, 1859) or *P.* (*T.*) *rainieria* Alexander but the relationship is remote. The specific name, *tacoma,* is derived from Mount Tacoma, an alternative name for Mount Rainier.

Pedicia (*Tricyphona*) *townesiana* Alexander, 1942.—Mt. Baker: Nooksack River, August 11, 1925 (*M*). Mt. Rainier: Altitude 5,300 ft., August 15, 1940 (*H. K. Townes*), type; altitude 4,500 ft., August 11, 1946 (*A*), along small stream among *Mimulus, Spiraea densiflora,* and others; Longmire Springs, 2,800 ft., August 10, 1946 (*A*), an unusually active flyer for a mem-



Figs. 20-26.—20. *Pedicia* (*Tricyphona*) *smithae* Alexander, venation; 21, the same showing variations in the radial field; 22. *Pedicia* (*Tricyphona*) *townesiana* Alexander, venation; 23. *Pedicia* (*Tricyphona*) *unigera* sp. nov., venation; 24. *Pedicia* (*Tricyphona*) *tacoma* sp. nov., male hypopygium; 25. *Pedicia* (*Tricyphona*) *townesiana* Alexander, male hypopygium; 26. *Pedicia* (*Tricyphona*) *unigera* sp. nov., male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *i*, interbase; *p*, phallosome; *t*, tergite).

ber of this tribe, occurring in small swarms of from 3 to 6 individuals, usually over a stream in small areas; Summerland Trail, July 24, 1924 (*M*); Van Trump Creek, September 1, 1917 (*M*); White River, July 20, 1924 (*M*).

Venation (Fig. 22): Among variations may be mentioned the following—R_{1+2} in cases much shorter than R_2; *r-m* variable in position, from before to beyond the fork of *Rs; r-m* at or just beyond the fork of *M*. Male hypopygium (Fig. 25) with the caudal margin of the tergite, *9t*, at either end of the extensive truncated median area with a low knob, provided with delicate setulae only; remainder of ninth segment with numerous setae, those on the sides large. Basistyle, *b*, with the interbase, *i*, a long curved rod, at apex a little dilated into a collar, the tip further produced into a strong pale conical spine; surface of interbase with several strong setae; apex of basistyle a broad lobe set with numerous blackened spinous pegs. Dististyle, *d*, a flattened blade, its tip obtuse; before apex of blade with three or four long setae; lower

margin near base with a single strong black spine. Phallosome, *p*, small and compact, the aedeagus decurved at apex; margins of the small appressed apophyses with microscopic roughenings.

Pedicia (Tricyphona) unigera sp. nov.—Size relatively small (wing, male, about 8 mm.); mesonotum brownish gray, the praescutum with four brownish stripes; knobs of halteres infuscated; legs brown; wings weakly tinged with brown; cell R_4 deep, its petiole subequal to *r-m*, the latter at midlength of R_{4+5}; cell *1st* M_2 closed, elongate; male hypopygium with the tergite transverse, the margin with two widely separated tubercles; interbase a simple twisted rod, the surface with numerous setae, the tip a pale acute spine; dististyle bifid, the outer portion a low lobe provided with numerous blackened spinous setae, the lower arm a longer pale blade.

♂. Length, about 7 mm.; wing, 8.2 mm.

♀. Length, about 9-12 mm.; wing, 8.8-10.5 mm.

Rostrum short, brownish gray; palpi black. Antennae brownish black, scape pruinose; flagellar segments oval. Head dark grayish brown; anterior vertex broad.

Pronotum brownish gray. Mesonotal praescutum brownish gray with four slightly darker brown stripes, the lateral borders and humeral region paler; tuberculate pits black, pseudosutural foveae pale; scutal lobes dark brown, the posterior and lateral portions paler; scutellum, mediotergite and central part of scutum gray pruinose, parascutella paler; pleurotergite chiefly pale. Pleura brownish gray, the dorsal sternopleurite somewhat paler, the ventral sternopleurite darkest. Halteres with stem yellow, knob infuscated. Legs with the coxae and trochanters pale yellow, remainder of legs brown, scarcely variegated. Wings (Fig. 23) weakly tinged with brown, the oval stigma vaguely darker; wing base a little brightened; veins brown. Venation: Sc_1 ending beyond the fork of R_{4+5}, Sc_2 far before origin of *Rs; Rs* long, a trifle shorter than R_{2+3}; R_2 erect or bent slightly backward, longer than R_{1+2}; cell R_4 deep, its petiole subequal to *r-m*, the latter being at midlength of R_{4+5}; cell *1st* M_2 normally closed, elongate, *m* connecting with vein M_2 about its own length beyond the fork; *m-cu* at fork of *M*.

Abdomen dark brown, the caudal borders of the tergites narrowly obscure yellow, of the sternites more broadly so. Male hypopygium (Fig. 26) with the tergite, *9t*, transverse, the caudal margin with two widely separated lobules. Basistyle, *b*, truncate at apex; interbase, *i*, a simple twisted rod or blade, gradually narrowed to an acute pale spine; surface with numerous setigerous punctures that bear pale inconspicuous setae. Dististyle, *d*, large and complex, bifid, the outer portion a low lobe provided with numerous blackened spinous setae, the lower arm a longer pale blade, at its apex expanded into a rounded spatula, the lower margin with two erect setae that are larger and stronger than the other setulae. Phallosome, *p*, having the small simple aedeagus subtended by shorter apophyses, the tips of the latter obtusely rounded, with small pale punctures.

Holotype, ♂, Hazel Creek, 5 miles above Dexter, Willamette National

Forest, Oregon, altitude 990 ft., August 5, 1946 (*C. P. Alexander*); Hazel Creek flows into the Middle Fork of the Willamette River. *Allotopotype*, ♀, Big Meadow, North Santiam Highway, Oregon, August 17, 1947 (*Fender*). *Paratypes*, 1 ♀, Wonderland Trail, Mt. Rainier, Washington, above White River Camp, 5,500 ft., August 1, 1947 (*M. M. Alexander*), flying over a small mountain stream; 1 ♀, Boulder Lake Trail, Olympic National Park, Washington, 3,500 ft., August 5, 1947 (*M. M. Alexander*), swept from herbage along a small mountain torrent.

The most similar described species is *Pedicia* (*Tricyphona*) *townesiana* Alexander, 1942, which differs in the body coloration, venation, and in all details of structure of the male hypopygium.

Dicranota (*Dicranota*) *argentea* Doane, 1900 (*montana* Alexander, 1920).—Seattle, March 22, 1898 (*Kincaid*), type of *argentea*. Mt. Rainier: Dutch's Creek, Elbe, July 24, 1947, August 10-13, 1946 (*A*).

Dicranota (*Polyangaeus*) *maculata* (Doane, 1900).—Olympia (*Kincaid*); Seattle (*Kincaid*), types. East Port Orchard, September 23-26, 1946 (*Fender*); Lewis & Clark State Park, September 28, 1946 (*Fender*).

Dicranota (*Rhaphidolabis*) *cayuga* (Alexander, 1916).—Mt. Baker: Galena Camp, 4,000 ft., August 14, 1947 (*A*). Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946 (*A*).

Dicranota (*Rhaphidolabis*) *integriloba* Alexander, 1943.—Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*).

Dicranota (Rhaphidolabis) neomexicana subtruncata subsp. nov.—♂. Length, about 5.5-6 mm.; wing, 6.5-6.8 mm.

♀. Length, about 5-6 mm.; wing, 6-6.5 mm.

Characters as in the typical form, differing in slight details of the male hypopygium. Median region of the ninth tergite virtually truncate, the margin at this point very slightly convex and with a concentration of setae. Two or three setae near apex of dististyle long and conspicuous. In typical *neomexicana* (Alexander, 1912), the median region of the tergite is produced into a broad-based lobe with the setae concentrated at the apex of this produced portion.

Holotype, ♂, Deer Park, Olympic National Park, 5,400 ft., August 6, 1947 (*C. P. Alexander*). *Allotopotype*, ♀. *Paratopotype*, 1 ♂, 1 ♀.

Dicranota (Rhaphidolabis) nooksackensis sp. nov.—General coloration of thorax brownish gray, the praescutum with three brownish black stripes; antennae (male) relatively elongate, exceeding one-fourth the length of wings; wings subhyaline, the stigma darker brown; *Sc* short, Sc_1 ending before the fork of *Rs;* cell R_3 varying from sessile to long-petiolate; male hypopygium with the tergite large, its caudal border emarginate; basistyle on apex of mesal face bearing a long tubercle that terminates in a long straight spine; aedeagus elongate, its tip directed strongly dorsad.

♂. Length, about 5-5.2 mm.; wing, 5.8-6 mm.; antenna, about 1.6-1.7 mm.

♀. Length, about 5.5 mm.; wing, 6.2 mm.

Rostrum gray; palpi black. Antennae 13-segmented, elongate in male, as shown by the measurements; black throughout, the scape a trifle more pruinose; flagellar segments (male) long-oval, verticils about one-half as long as the segments; remainder of surface with shorter coarse setae. In female, antennae shorter but still longer than usual in the genus. Head brownish gray; vertex broad.

Thorax brownish gray, the praescutum with three brownish black stripes; scutal lobes similarly patterned with black; median region of scutum and the scutellum light gray. Pleura and pleurotergite light gray. Halteres brownish black, the base of stem yellow. Legs with the coxae gray pruinose; trochanters yellow; remainder of legs brown, the femoral bases yellow. Wings (Figs. 27, 28) subhyaline, the oval stigma very pale brown; veins dark brown. Venation: *Sc* short, Sc_1 ending about opposite one-half to two-thirds *Rs; Rs* relatively long, angulated and usually spurred beyond origin; cell R_3 sessile (Fig. 28) to petiolate (Fig. 27), in cases with R_{2+3+4} longer than R_2 or the basal section of R_5; R_2 transverse, longer than R_{1+2}; cell M_2 open; *m-cu* from one-third to one half its length beyond the fork of *M*.

Abdomen brownish black, sparsely pruinose; hypopygium dark, the apices of the appendages paling to brownish yellow. Male hypopygium (Fig. 31) with the tergite, *9t*, large, the caudal border broadly emarginate, the base of the notch with pale membrane; outer apical angles slightly produced, the margin back from this point with abundant microscopic spicules; outer lateral portions of tergite behind the apical angles more or less inflated. What appears to represent an interbase is a small slender blade that is separated from the tergite by a deep notch. Basistyle, *b*, on mesal face near apex produced into a strong tubercle that terminates in an even longer straight black spine. Two dististyles, *d*, the outer a fleshy dusky lobe that is slightly enlarged outwardly, the tip broadly obtuse, the surface of the inner face with long erect setae, those of the outer face shorter and more appressed; inner dististyle shorter, terminating in a flattened spatulate blade. Aedeagus, *a*, elongate, conspicuous, the tip directed strongly dorsad.

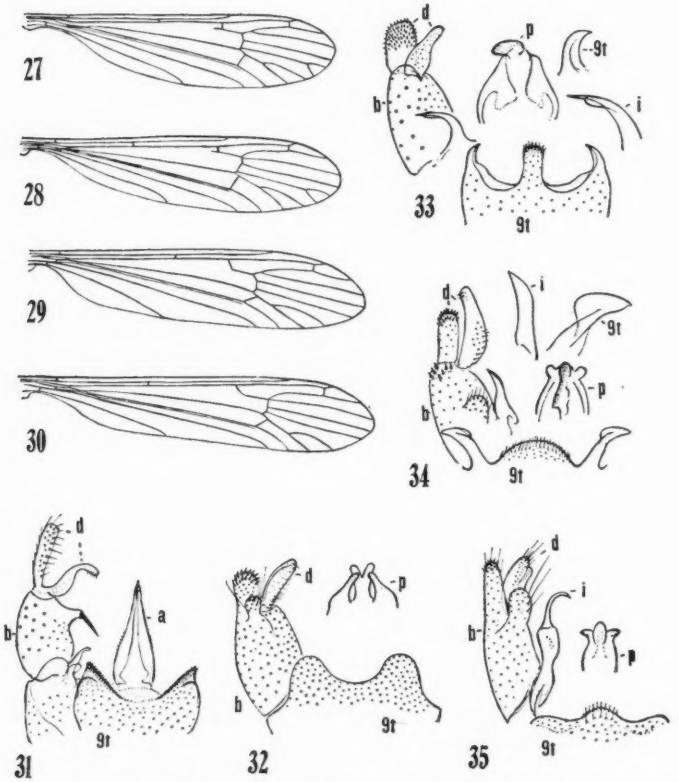
Holotype, ♂, Silver Fir Camp, Mt. Baker, along the banks of the North Fork of the Nooksack River, 1,990 ft., August 13, 1947 (*C. P. Alexander*). *Allotopotype*, ♀, pinned with type. *Paratopotype*, 5 ♂♀, August 13-15, 1947 (*C. P. Alexander*).

Dicranota (*Rhaphidolabis*) *nooksackensis* is very different from all other Nearctic species, being most similar in its general facies to species like *D.* (*R.*) *nuptialis* Alexander, 1947. The venation, especially the short *Sc*, structure of the male hypopygium, and the elongate antennae, all mark the species as being very distinct. The venation of the radial field is remarkably variable, lending further strong support to the writer's theory of venation as it pertains to the radial field in the Diptera.

Dicranota (*Rhaphidolabis*) *polymeroides* (Alexander, 1914).—Hoods-

port, September 22, 1946 (*Fender*); Twanoh State Park, September 22, 1946 (*Fender*).

Dicranota (*Rhaphidolabis*) *stigma* (Alexander, 1924).—Mt. Rainier: Longmire Springs, 2,800 ft., June 1917 (*Dyar*), types. No other specimens are known to me with the exception of the paratype from Colorado. This latter, while based on a female specimen, appears to be conspecific but the discovery of the male sex may prove it to be an allied new form.



Figs. 27-35.—27. *Dicranota* (*Rhaphidolabis*) *nooksackensis* sp. nov., venation; 28. the same, variation; 29. *Dicranota* (*Plectromyia*) *kulshanensis* sp. nov., venation; 30. *Dicranota* (*Plectromyia*) *nooksackiae* sp. nov., venation; 31. *Dicranota* (*Rhaphidolabis*) *nooksackensis* sp. nov., male hypopygium; 32. *Dicranota* (*Rhaphidolabis*) *stigma* Alexander, male hypopygium; 33. *Dicranota* (*Plectromyia*) *kulshanensis* sp. nov., male hypopygium; 34. *Dicranota* (*Plectromyia*) *nooksackiae* sp. nov., male hypopygium; 35. *Dicranota* (*Plectromyia*) *cascadica* sp. n., male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *i*, interbase; *p*, phallosome; *t*, tergite).

In the structure of the male hypopygium, the species is very peculiar and isolated in the Nearctic fauna but there are more nearly allied species in Eastern Asia. The conformation of the tergite and loss of the interbasal process are especially noteworthy. Male hypopygium (Fig. 32) with the tergite, *9t*, very large, its caudal margin broadly notched, the lateral lobes thus formed narrower than the central emargination, their apices broadly rounded or feebly subtruncate; surface of tergite, including the lobes, with abundant delicate setulae and less abundant scattered pale setae (the latter indicated in the figure by setigerous punctures). Basistyle, *b*, without an interbasal process; at apex with two oval lobes, the outer one larger, provided with about a score of unusually strong spinous setae; the smaller and lower lobe provided with a few scattered very long pale setae and, in some specimens only, with two or three stout spinous setae. Dististyle, *d*, considerably longer than the outer lobe of the basistyle, appearing as an elongate foot-shaped blade, the lower margin of the basal half fringed with about a dozen long setae; face of outer half of style with scattered shorter setae; dorsal edge of style more or less thickened. Phallosome, *p*, small, the aedeagus giving evidence of being bifid or bilobed at apex (this structure visible in one slide only).

Dicranota (*Rhaphidolabis*) *subsessilis* (Alexander, 1921).—Mt. Baker: Swift Creek Trail, 4,300 ft., August 12, 1947 (*A*).

Dicranota (*Rhaphidolabis*) *xanthosoma* Alexander, 1944.—Olympic National Park: Boulder Lake Trail, 2,200-3,500 ft., August 5-7, 1947 (*A*); a few individuals from here and elsewhere have cell *1st* M_2 closed by the retention of *m*. Mt. Rainier: Longmire Springs: 2,800 ft., July 22-23, 1947 (*A*), August 10, 1946 (*A*); Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*); White River, July 20, 1924 (*M*). Mt. St. Helens: Toutle River below Spirit Lake, 3,000 ft., July 20, 1947 (*A*).

Dicranota (Plectromyia) cascadica sp. nov.—General coloration buffy brown, the praescutum with a broad dark brown central stripe and less evident lateral ones; antennae short; wings narrow, subhyaline; cell R_3 long-petiolate, R_{2+3+4} being approximately one half *Rs;* male hypopygium with the median region of the tergite only slightly produced; basistyle at apex produced into two lobes, the outer one more elongate, tipped with strong spinous setae; interbase large and conspicuous, the apical third abruptly narrowed into a gently curved spine.

♂. Length, about 5.5 mm.; wing, 6 mm.

Rostrum brownish black; palpi black. Antennae short, 13-segmented; flagellar segments oval to subcylindrical; verticils shorter than the segments. Head dark gray; anterior vertex narrow.

Pronotum dark brown. Mesonotum light brown or buffy brown, the praescutum with a broad conspicuous dark brown median stripe and paler, narrower lateral ones; mediotergite a trifle darkened. Pleura and pleurotergite buffy. Halteres with the stem yellow, knob infuscated. Legs with the coxae and trochanters yellow; remainder of legs pale brown, the tips of the femora and tibiae weakly more darkened; outer tarsal segments brown. Wings narrow,

subhyaline, the stigma scarcely darker; extreme wing base pale yellow; veins brown, those near base more yellowed. Venation: Sc_1 ending shortly beyond the fork of *Rs*, Sc_2 very far basad, at near mid-distance between arculus and origin of *Rs*, the latter strongly arcuated; cell R_3 long-petiolate, R_{2+3+4} being approximately one-half *Rs*; R_2 transverse; R_{1+2} very short; cell M_3 subequal to its petiole; *m-cu* shortly beyond the fork of *M*; cell *2nd A* broad.

Abdomen dark brown, the hypopygium a trifle more brightened. Male hypopygium (Fig. 35) with the median region of the ninth tergite, *9t*, only slightly produced, moderately convex, with numerous slender setae. Basistyle, *b*, at apex produced into two lobes, an outer cylindrical one that bears approximately a score of strong spinous setae on its apical fourth, and a smaller more oval lobe with fewer very elongate setae; interbase, *i*, large and conspicuous, the expanded basal portion strongly constricted at near midlength, the face of the outer part with a row of about six setae; outer third or less of the structure abruptly narrowed into a gently curved spine, the tip acute. Dististyle, *d*, a little longer than the outer lobe of the basistyle, the apex weakly notched, the upper lobe thus formed provided with several strong setae.

Holotype, ♂, Longmire Springs, Mt. Rainier, 2,800 ft., August 13, 1946 (*C. P. Alexander*).

Dicranota (*Plectromyia*) *cascadica* is entirely distinct from the other regional members of the subgenus in the structure of the male hypopygium, particularly the slightly produced tergite, basistyle, interbase and dististyle. It is most similar to *D.* (*P.*) *nooksackiae* sp. nov. and to *D.* (*P.*) *townesi* Alexander, 1940, of the southern Appalachian mountains.

Dicranota (Plectromyia) kulshanensis sp. nov.—Mesonotum brownish gray, the praescutum with three brown stripes; antennae black throughout; wings milky white, the stigma barely indicated; veins pale brown, inconspicuous; *Rs* angulated and short-spurred beyond origin; cell R_3 short-petiolate; male hypopygium with the median region of tergite produced into an elongate parallel-sided lobe, the lateral tergal arms appearing as small, slightly curved horns, the tips acute; interbase irregularly bidentate at apex; two dististyles, the outer a stout pale lobe that is provided with abundant blackened spines; inner style more or less bottle-shaped, the outer end darkened.

♂. Length, about 6 mm.; wing, 6.7-6.8 mm.

♀. Length, about 6.5 mm.; wing, 6.8 mm.

Rostrum brownish gray; palpi black. Antennae black throughout, apparently 12-segmented; flagellar segments oval. Head buffy gray.

Mesonotum brownish gray, the praescutum with three brown stripes, the median one more or less divided to produce four vittae; scutal lobes darkened; median region of scutum and the scutellum more testaceous yellow; postnotum and pleura pale gray, the ventral sternopleurite slightly more darkened. Halteres pale, the knobs darkened. Legs with the coxae and trochanters pale yellow; remainder of legs brown, the femoral bases restrictedly pale yellow. Wings (Fig. 29) milky white, the stigma barely indicated; veins pale brown,

inconspicuous, the more basal veins, especially *M*, very pale. Venation: *Sc* long, Sc_1 ending some distance beyond the fork of R_{2+3+4}; *Rs* angulated and short-spurred beyond origin; cell R_3 short-petiolate by an element R_{2+3+4}; R_2 transverse, in cases subobsolete; M_4 subequal to or longer than the second section of M_{3+4}; cell *2nd A* broad.

Abdomen dark brown, very sparsely pruinose; hypopygium yellow. Male hypopygium (Fig. 33) with the median region of the tergite, *9t*, produced into an elongate parallel-sided lobe, the apex truncated to gently convex, the surface with abundant pale setae from pale inconspicuous punctures; lateral tergal arms appearing as small, slightly curved horns, the tips acute. Basistyle, *b*, with the interbase, *i*, much larger than the tergal arms, unequally bidentate at tip, one arm a long slender spine, the other a shorter more flattened blade; apex of basistyle obtusely rounded, without spines. Two dististyles, *d*, the outer a stout pale lobe, its tip obtuse, the outer two-thirds with abundant blackened spines; this style evidently derived from the basistyle but separated therefrom by a distinct suture; inner dististyle subequal in length, appearing as a broad-based lobe that is more or less bottle-shaped, the outer half more narrowed, the tip obtuse, darkened. Phallosome, *p*, small and compact, as common in the tribe; aedeagus darkened, obtuse at tip.

Holotype, ♂, Austin Pass, Mt. Baker, 4,300 ft., along small stream, August 14, 1947 (*C. P. Alexander*). *Allotopotype*, ♀, pinned with type. *Paratopotype*, 1 fragmentary ♂, Swift Creek Trail, Mt. Baker, 4,300 ft., August 12, 1947 (*C. P. Alexander*); *paratypes*, ♂ ♀, Boulder Lake Trail, Olympic National Park, 3,500 ft., August 5, 1947 (*C. P. Alexander*).

Most similar to species such as *Dicranota* (*Plectromyia*) *cascadica* sp. nov., and *D.* (*P.*) *nooksackiae* sp. nov., all three differing among themselves chiefly in hypopygial characters, as described and figured.

Dicranota (Plectromyia) nooksackiae sp. nov.—Mesonotum brownish yellow, the praescutum with a brownish black median stripe; antennae with scape brownish yellow, flagellum black; wings whitish subhyaline, veins pale brown; cell R_3 narrowly sessile; male hypopygium with the median region of tergite produced into a low convex lobe, the lateral arms twisted, terminating in flattened blades with subacute tips; interbase smaller, horn-like; face of basistyle, opposite the interbase, with a conspicuous setiferous lobe; apex of basistyle with a few spinous points.

♂. Length, about 4.8-5 mm.; wing, 5-5.5 mm.

Rostrum testaceous yellow; palpi black. Antennae 13-segmented; scape brownish yellow, pedicel a trifle darker, flagellum black; flagellar segments oval, the verticils subequal in length to the segments. Head brownish gray.

Pronotum brown. Mesonotal praescutum brownish yellow, with a broad brownish black median stripe and scarcely indicated lateral ones; scutal lobes weakly darkened, the remainder of mesonotum brownish yellow. Pleura brownish yellow, including the dorsopleural membrane. Halteres yellow, the knobs brownish black. Legs with the coxae and trochanters yellow; remainder of legs brown, the femoral bases restrictedly yellow; tarsi darker. Wings

(Fig. 30) whitish subhyaline, entirely unpatterned; prearcular field a little more yellowed; veins brown, those near the wing base, including the main stem of *M*, paler. Venation: *Sc* long, Sc_1 ending about opposite one-third the length of R_{2+3}, Sc_2 at near midlength of *R*; *Rs* relatively long, angulated at origin; R_2 slightly oblique, about three times R_{1+2}; cell R_3 narrowly sessile, vein R_4 in direct alignment with *Rs*; cell *2nd A* relatively wide.

Abdomen dark brown, with an even darker subterminal ring; hypopygium obscure yellow. Male hypopygium (Fig. 34) with the median region of tergite, *9t*, produced into a low convex lobe, the surface with abundant pale setae; lateral tergal arms appearing as long twisted rods that terminate in a flattened blade, the tip subacute. Basistyle, *b*, with the interbase, *i*, a smaller horn, its tip acute; face of style opposite the interbase with a conspicuous lobe that is provided with long coarse setae; apex of basistyle with relatively few blackened spines. Two dististyles, *d*, the outer at apex with about a score of blackened spines; inner style about one-third longer, narrowed to the obtuse tip. Phallosome compact, the aedeagus blackened.

Holotype, ♂, Silver Fir Camp, Mt. Baker, 1,990 ft., along the North Fork of the Nooksack River, August 13, 1947 (*C. P. Alexander*). *Paratypes*, 6 ♂♂, Big Meadow, North Santiam Highway, Oregon, August 17, 1947 (*Fender*).

Dicranota (*Plectromyia*) *nooksackiae* is quite different from the other regional members of the subgenus, differing particularly in the structure of the male hypopygium, as the ninth tergite and interbase. Superficially it is most like *D.* (*P.*) *kulshanensis* sp. nov., which has the male genitalia quite distinct.

Dicranota (*Plectromyia*) *reducta* (Alexander, 1921).—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*). Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., July 22, 1947, August 10-13, 1946 (*A*); below Paradise Valley, 4,700 ft., July 11, 1940 (*Townes*), 5,200 ft., August 11, 1946 (*A*). Mt. St. Helens: Toutle River below Spirit Lake, 3,000 ft., July 20, 1947 (*A*).

HEXATOMINI

Paradelphomyia (*Oxyrhiza*) *pacifica* (Alexander, 1944).—Mt. Rainier: Longmire Springs, 2,800 ft., July 22-24, 1947 (*A*); Wonderland Trail, above White River, 4,700-4,800 ft., August 1, 1947 (*A*). Barnes State Reservation, September 27, 1946 (*Fender*); Everett, July 4, 1924 (*M*); Ilwaco, May 5, 1918 (*M*); La Center, July 6, 1917 (*M*); Lewis & Clark State Park, September 28, 1946 (*Fender*); Twanoh State Park, September 22, 1946 (*Fender*).

Austrolimnophila badia (Doane, 1900).—Olympia, May 1, 1894 (*Kincaid*), type. Mt. Baker: Glacier, June 4, 1917 (*Dyar*). Olympic National Park: Lake Cushman, June 27, 1917 (*Dyar*). Mt. Rainier: Ashford, June 9, 1921 (*Dyar*); Elbe, 1,200 ft., July 24, 1947 (*A*); Longmire Springs, 2,800 ft., June 27, 1935 (*M*). Everett, June 19, 1920 (*M*); Hoquiam, May 27,

1917 (*Dyar*); Ilwaco, May 5, 1918, July 12, 1922 (*M*); La Center, July 8, 1917 (*M*); Olympia, June 22, 1920 (*M*); Seattle, May 21, 1897 (*Kincaid*), larvae on May 7, 1942 (*E. I. Smith*, in U.S.N.M.); Snoqualmie Falls, May 16, 1931 (ex *Kincaid*); Valleyford, May 29, 1921 (*M*).

Pseudolimnophila contempta (Osten Sacken, 1869) (*nigripleura* Alexander & Leonard, 1914).—Walla Walla, 1,000 ft., May 28, 1938 (*M. C. Lane*). Doubtful record; see discussion earlier under Walla Walla.

Dactylolabis adventitia Alexander, 1942.—Pullman, Lyle Grove, May 1921, May 30, 1922 (*M*); Wawawai, on bluffs along the Snake River, April 7, 1918 (*M*).

Dactylolabis nitidithorax (Alexander, 1918).—Olympic National Park: Boulder Lake Trail, 3,200-3,500 ft., August 5, 1947, in small swarms near ground beneath fir and mountain hemlock (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., July 22, 1947 (*A*), August 10-13, 1946 (*A*). Mt. St. Helens: Toutle River below Spirit Lake, 3,000 ft., July 20-21, 1947 (*A*), in small swarms near decaying coniferous logs in woods; when at rest on leaves, the wings held incumbent over back; rest on leaves of alder, vanilla leaf, dwarf cornus and other low plants. It should be noted that some specimens, particularly the females, have the praescutal stripes and disk more yellowed than normal for the species.

Dactylolabis pteropoecila (Alexander, 1921).—Forks, July 1, 1920 (*E. P. Van Duzee*), type.

Dactylolabis sparsimacula Alexander, 1942.—Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Tipsoo Lake, Chinook Pass, 5,400 ft., July 31, 1947 (*A*); Wonderland Trail and Yakima Park, 5,700-6,500 ft., August 1-3, 1947 (*A*).

Phyllolabis fenderiana sp. nov.—General coloration dark brown, the mesonotum unpatterned; antennal flagellum black; wings with a strong brownish tinge, the stigmal region somewhat darker brown; *Rs* and R_{2+3+4} subequal in length, a little shorter than vein R_3; male hypopygium with the appendage of the ninth sternite unequally trilobed; outer portion of basistyle produced into two lobes; upper dististyle a slender sinuous rod, at apex expanded into a head; gonapophyses very slender.

♂. Length, about 6-7.5 mm.; wing, 6.3-7.4 mm.

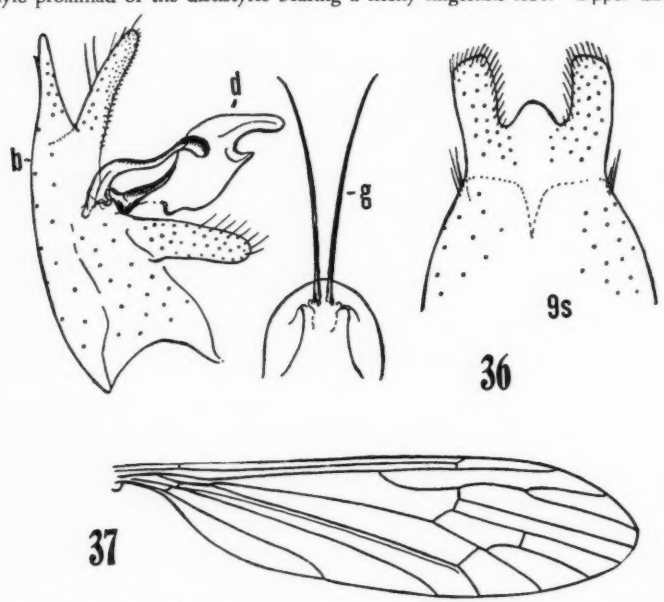
♀. Length, about 7 mm.; wing, 7.5 mm.

Rostrum gray; palpi dark brown. Antennae with scape gray pruinose, pedicel brown, flagellum black; flagellar segments subcylindrical to elongate-oval, the verticils exceeding the segments. Head brownish gray, the anterior vertex clearer brown.

Pronotum dark brown. Mesonotum almost uniformly dark brown, unpatterned, the pretergites restrictedly obscure yellow; parascutella and posterior portions of scutal lobes more yellowed. Pleura almost uniformly dark brown,

the dorsopleural membrane and propleura somewhat paler. Halteres with stem dirty white, the knob infuscated. Legs with the coxae obscure yellow, the fore pair somewhat more darkened; trochanters obscure yellow; remainder of legs dark brown, the bases of the femora obscure yellow. Wings (Fig. 37) with a strong brownish tinge, the stigmal region somewhat darker brown; prearcular field a trifle more yellowed; veins brown, somewhat paler at and near the wing base. Costal border above the stigma trifle dilated but not to such a degree as in *lagganensis*. Venation: *Rs* and R_{2+3+4} subequal in length, both a little shorter than vein R_3; cell *1st* M_2 long, subequal to the distal section of vein M_{1+2}; *m-cu* a short distance before the fork of M_{3+4}.

Abdomen, including the hypopygium, dark brown, the eighth segment still darker. Male hypopygium (Fig. 36) with the ninth sternite narrowed outwardly, its base darkened, the appendage, *9s*, abruptly yellow, conspicuously trilobed; lateral lobes longer, broadly obtuse at tips, provided with long setae, especially at apex and on inner margin; median lobe low and obtuse, glabrous. Basistyle, *b*, produced beyond the point of insertion of the dististyles, the apex conspicuously bilobed; outer lobe shorter and more sclerotized, acute at tip and bearing a small secondary point on outer face before tip; inner lobe obtuse at tip, the apex and lower margin with abundant short setae; mesal face of basistyle proximad of the dististyles bearing a fleshy fingerlike lobe. Upper disti-



Figs. 36-37.—36. *Phyllolabis fenderiana* sp. nov., male hypopygium; 37, *Phyllolabis fenderiana* sp. nov., venation. (Symbols: *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *s*, sternite).

style a narrow sclerotized glabrous rod, very sinuous, at apex expanded into a flattened obtuse head. Inner dististyle, *d*, longer, glabrous, shaped about as figured, the outer lobe obtuse. Gonapophyses, *g*, appearing as unusually slender spines, narrowed to the very slightly curved tips.

Holotype, ♂, Sahale Falls, East Fork of the Hood River, Mt. Hood, Oregon, altitude 4,575 ft., August 8, 1946 (*K. M. Fender*), swept from sparse vegetation at foot of falls. *Allotopotype*, ♀, July 17, 1947 (*K. M. Fender*). *Paratypes*, several ♂ ♀, Galena Camp, Mt. Baker, altitude 4,000 ft., August 10-14, 1947 (*M. M. and C. P. Alexander*). The paratypical series was found on sloping rock exposures near our camp, described earlier. They were found walking about over the rock surfaces or resting on the white heather, *Cassiope Mertensiana*, nearby. A few pairs were taken while "in copula." Although the immature stages could not be located, it seems evident that they occur in the thin sheets or mats of moss that cover parts of these rocky outcrops. The species was commonly found in association with *Elliptera astigmatica* which it superficially resembles. Adjoining the margins of the outcrops were extensive beds of a saxifrage, *Saxifraga ferruginea* Graham, on this date in full flower.

I take unusual pleasure in dedicating this interesting species to Kenneth Mark Fender, to whom we owe much of our recent knowledge of the insect fauna of the Pacific Northwest. The fly is entirely distinct from the other known species in the structure of the male hypopygium, particularly the bilobed apex of the basistyle, the conformation of the appendage of the ninth sternite, and the structure of the outer dististyle. It is most similar to species such as *Phyllolabis bryantiana* Alexander, 1931, and *P. latifolia* Alexander, 1920, yet entirely distinct.

Phyllolabis lagganensis Alexander, 1931.—Mt. Baker: Galena Camp, 4,100 ft., August 12, 1947 (*A*), swept from mountain hemlock on talus slopes above the camp; associated with the Ascaphid frog, *Ascaphus truei* Stejneger. Mt. Rainier: Cayuse Pass, 4,300 ft., July 30, 1947 (*A*).

Limnophila (*Elaeophila*) *aldrichi aldrichi* Alexander, 1927.—Mt. Baker: Galena Camp, 4,000 ft., August 11, 1947; males in small swarms at dusk (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 23, 1947 (*Remington*).

Limnophila (Elaeophila) aldrichi abrupta subsp. nov.—Thorax gray, the praescutum with four poorly-indicated more brownish gray stripes; antennal flagellum yellow; femora yellow, the tips narrowly and rather inconspicuously darkened; wings whitish subhyaline, conspicuously patterned with brown, all markings being restricted to the vicinity of the veins; abdomen bicolored, the segments obscure yellow with about the outer third brown; male hypopygium with the outer dististyle relatively narrow, the outer flange small, pointed, placed at near midlength of the outer margin.

♂. Length, about 7-8 mm.; wing, 8-9 mm.; antenna, about 1.4-1.5 mm.

Rostrum gray; palpi brownish gray. Antennae with the scape pruinose; pedicel brownish testaceous; flagellum light yellow, the outer segments a trifle

more darkened; basal flagellar segments oval, the outer ones more elongate; verticils longer than the segments. Head brownish gray.

Pronotum gray. Mesonotum gray or brownish gray, the praescutum with four poorly-indicated more brownish gray stripes, the intermediate pair separated by a line that is about one-third to one-fourth the width of either stripe; scutal lobes vaguely darkened. Pleura dark gray, the dorsopleural membrane dusky. Halteres pale yellow. Legs with the coxae pale brown to brownish yellow, the posterior pair clearer yellow; trochanters yellow; femora yellow, the tips narrowly and rather inconspicuously darkened; tibiae and proximal three tarsal segments yellow, the tips very narrowly infuscated; outer tarsal segments more uniformly darkened. Wings (Fig. 38) whitish subhyaline, conspicuously patterned with brown, as follows: An arcular darkening, extending from *h* into the base of cell *Cu;* a second area in costal cell about mid-distant between arculus and origin of *Rs,* not quite reaching *M* behind; a dark area at origin of *Rs,* in the holotype extending the full length of this vein and connecting with the central darkened areas; cord and outer end of cell *1st* M_2 seamed with brown; stigmal area relatively small; small brown marginal spots at ends of all longitudinal veins with the exception of R_5, the largest at R_4, and *2nd A;* cells R_3 and R_5 extensively suffused with brown, especially in the holotype; veins beyond cord brown, basad of cord yellow in the interspaces, brown in the clouded areas. Venation: *Rs* square and spurred at origin; R_2 close or just beyond the fork of R_{2+3+4}; cell M_1 small to very small (in holotype). In the type male there are three adventitious crossveins in cell R_1 above *Rs;* supernumerary crossvein in cell *M* lacking.

Abdomen bicolored, the segments obscure yellow with about the outer third brown; subterminal segments uniformly dark brown to form a subterminal ring; hypopygium more weakly infuscated. Male hypopygium with the outer dististyle relatively narrow, the outer flange small to very small (holotype), pointed, placed below (in type) to near midlength of outer margin of style; margin beyond this point with about 10 to 12 appressed denticles. Inner dististyle long-oval, with about a score of normal setae. In *modoc* both dististyles differ in conformation and armature.

Holotype, ♂, Hood River Meadows, Mt. Hood, Oregon, 4,480 ft., August 8, 1946 (*C. P. Alexander*). *Paratype,* ♂, Olympic Hot Springs, Olympic National Park, Washington, 2,200 ft., August 7, 1947 (*C. P. Alexander*).

The type specimen is the apparently abnormal individual discussed throughout the above description. In most regards, with the exception of the wing pattern and venation, this seems to be identical with the later discovered paratype and until more material is discovered the latter should be considered as being the normal individual. In the type the presence of three extra crossveins in the radial field and the loss of the supernumerary crossvein in cell *M* are very striking characters. From typical *Limnophila* (*Elaeophila*) *aldrichi,* it differs in slight details of coloration and in the structure of the male hypopygium.

Limnophila (*Elaeophila*) *shannoni* Alexander, 1921.—Mt. Rainier: Won-

derland Trail above White River, 5,300 ft., August 1, 1947 (*A*).

Limnophila (*Elaeophila*) *superlineata* Doane, 1900.—Olympia, April 10-19, 1894 (*Kincaid*); Wawawai, April 24, 1897 (*Doane*), types.

Limnophila (*Prionolabis*) *barberi* Alexander, 1916.—Fort Lewis, May 18-19, 1946 (*Arnaud*).

Limnophila (*Prionolabis*) *boharti* Alexander, 1943.—Mt. Rainier: Eagle Peak, July 19, 1922 (*M*); Wonderland Trail, above the White River, 5,700-5,800 ft., August 1, 1947 (*A*). The venation of the male is shown (Fig. 39); in the female, the wings are reduced, apparently more so at the higher altitudes.

Limnophila (*Prionolabis*) *oregonensis* Alexander, 1940.—Ilwaco, May 5, 1918 (*M*).

Limnophila (Prionolabis) paramunda sp. nov.—General coloration black, the praescutum and scutal lobes polished, the remainder pruinose; antennae 16-segmented, the basal flagellar segments suboval, the outer ones cylindrical; halteres yellow; femora yellow, the tips blackened; wings tinged with yellow, restrictedly patterned with brown, including seams over *Rs*, cord and the entire length of vein *Cu;* male hypopygium with the tergal lobe broad, the sternite much narrower, unequally trilobed at apex; lobe on mesal face of basistyle relatively stout; outer dististyle with distal half slender, unequally bifid at tip, without a spine at the point of narrowing.

♂. Length, about 7.5-8.5 mm.; wing, 8-9 mm.

Rostrum and palpi black. Antennae 16-segmented, dark brown, the pedicel and base of first flagellar segment paler; basal flagellar segments suboval or a trifle produced on the lower face; outer eight or nine segments cylindrical, longer than the verticils. Head dark gray.

Pronotum dark gray. Praescutum and scutum black, highly polished; posterior sclerites of notum, including the median region of the scutum, more pruinose. Pleura black, pruinose; dorsopleural membrane brownish yellow. Halteres yellow. Legs with the coxae obscure yellow, sparsely pruinose, the fore coxae darker, especially at bases; trochanters yellow; femora yellow, the tip blackened, broadly so on the fore and middle legs, narrower on the posterior femora where only about the outer eighth is included; tibiae yellow, the extreme base and broader tips infuscated; tarsi brownish black to black. Wings (Fig. 40) with a yellowish tinge, the prearcular and costal fields clearer yellow; a restricted brown pattern, including seams along *Rs*, cord, outer end of cell *1st* M_2 and fork of M_{1+2}; a very broad seam along vein *Cu*, chiefly in cell *Cu;* stigma oval, darker brown; veins brown, yellow in the brightened fields. Venation: Sc_1 ending shortly beyond the fork of *Rs*, Sc_2 at its tip; R_{2+3+4} about one-half longer than the basal section of R_5; cell M_1 shorter than its petiole; *m-cu* at or just beyond one-third the length of cell *1st* M_2.

Abdomen, including hypopygium, black. Male hypopygium (Fig. 42) with the tergite, *9t*, terminating in a broad median lobe, its caudal margin notched, the margin microscopically crenulate; sternite much narrower, the apex unequally trilobed, the median lobule much smaller. Basistyle, *b*, with

the lobe on mesal face relatively stout and conspicuous. Outer dististyle, *od*, with the outer half slender, the tip unequally bidentate, the outer spine more slender; at point of narrowing, the style weakly angulated but not produced into a spine, as in *munda*.

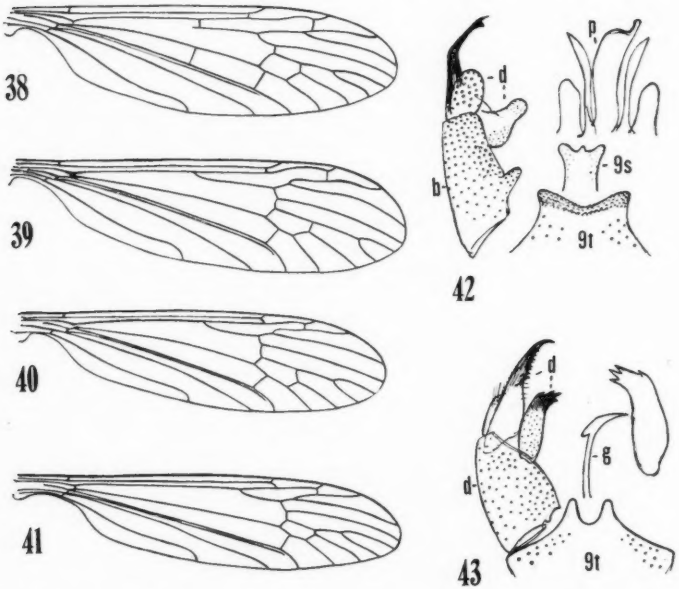
Holotype, ♂, Longmire Springs, Mt. Rainier, 2,800 ft., July 22, 1947 (*C. P. Alexander*). *Paratype*, ♂, Toutle River, below Spirit Lake, Cowlitz Co., July 20, 1947 (*C. P. Alexander*).

The present fly is very close to the eastern Nearctic *Limnophila* (*Prionolabis*) *munda* Osten Sacken, 1869, differing especially in the details of the male hypopygium, particularly of the tergite, sternite and outer dististyle.

Limnophila (*Prionolabis*) *scaria scaria* Alexander, 1945.—Index, August 2, 1917 (*M*).

Limnophila (Prionolabis) scaria trifida subsp. nov.—

♂. Length, about 8.5 mm.; wing, 9.5 mm.; antenna, about 2 mm. Characters as in the typical form, differing chiefly in the structure of the



Figs. 38-43.—38. *Limnophila* (*Elæophila*) *abrupta* sp. nov., normal venation; 39. *Limnophila* (*Prionolabis*) *boharti* Alexander, venation, male; 40. *Limnophila* (*Prionolabis*) *paramunda* sp. nov., venation; 41. *Limnophila* (*Phylidorea*) *olympica* sp. nov., venation; 42. *Limnophila* (*Prionolabis*) *paramunda* sp. nov., male hypopygium; 43. *Limnophila* (*Prionolabis*) *scaria trifida* subsp. nov., male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *id*, inner dististyle; *p*, phallosome; *s*, sternite; *t*, tergite).

male hypopygium. Antennae black throughout. Thorax gray, the praescutum and scutum less heavily pruinose. Fore femora with only the proximal fifth or sixth yellow, posterior femora with approximately the basal half brightened. Male hypopygium (Fig. 43) with the caudal margin of tergite, *9t*, produced into two slender lobes that are separated by a U-shaped notch. Outer dististyle, *d*, slender, as compared with the typical form, the inner margin with six or seven small teeth. Inner dististyle with the subapical tooth reduced, the apex with three strong teeth. In typical *scaria* the terminal teeth much more numerous. Gonapophyses, *g*, with the expanded heads elongate, produced into a beak, the outer margin at base of head produced backward into a flattened lobe or crest. In the type of *scaria* this prolongation is lacking but is indicated in further material of the race from Oregon.

Holotype, ♂, Longmire Springs, Mt. Rainier, 2,800 ft., July 22, 1947 (*C. P. Alexander*).

Limnophila (*Prionolabis*) *vancouverensis* Alexander, 1943.—Olympic National Park: Forks, July 1, 1920 (*E. P. Van Duzee*), types; Lake Cushman, June 27, 1917 (*Dyar*), types. Mt. Rainier: Ashford, June 7, 1921 (*Dyar*).

(Aldrich, *Catalogue*, p. 90, records *Limnophila* (*Prionolabis*) *rufibasis* Osten Sacken, 1859, from Wawawai, Washington, an evident lapsus for *L.* (*Elaeophila*) *superlineata* Doane, 1900).

Limnophila (*?Prionolabis*) *indistincta* Doane, 1900.—Olympic National Park: Olympic Hot Springs, 2,200 ft., August 7, 1947 (*A*); Lake Cushman, June 27, 1917 (*Dyar*). Mt. Rainier: Ashford, June 6-8, 1921 (*Dyar*); Longmire Springs, 2,800 ft., July 18, 1922 (*M*), August 14, 1917 (*M*), August 10-13, 1946 (*A*); Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*); Wonderland Trail, above White River, 5,500 ft., August 1, 1947 (*A*). Mt. St. Helens: Toutle River, below Spirit Lake, 3,000 ft., July 20-21, 1947 (*A*), associated with *Dactylolabis nitidithorax* (Alexander). Everett, June 19, 1920 (*M*); Ilwaco, July 12, 1922 (*M*); Lewis & Clark State Park, August 20, 1944 (*Knowlton*); Shelton, Walker's Park, July 21, 1917 (*M*). The reference of this fly to *Prionolabis* is provisional only.

Limnophila (*?Prionolabis*) *antennata* Coquillett, 1905.—Blewett, July 17, 1920 (*M*); Seattle, May 28 (*Kincaid*). The known range of the species extends from British Columbia, southward in the mountains to central California. The fly has not been adequately described and further notes are supplied herewith. Antennae (male) elongate, the segments long-cylindrical, much longer than the verticils; besides the latter, the segments with abundant erect setulae. Venation (Fig. 45): Sc_1 ending opposite the fork of *Rs* or virtually so, Sc_2 near its tip; *Rs* long; cell R_3 ranging from broadly sessile to very short-petiolate by the presence of a short element R_{2+3+4}, as shown; cell M_1 lacking; *m-cu* from about one-third to shortly before midlength of cell *1st* M_2; anterior arculus preserved. Male hypoygium (Fig. 48) with the caudal margin of the tergite, *9t*, with two very low, widely separated lobes. Basistyle, *b*, with a long-oval thickening or lobe on mesal face, this evidently representing the interbase. Dististyles, *d*, subterminal in position; outer style a stout heavily blackened trispinous structure, the axial or largest spine micro-

scopically scabrous. Phallosome, *p*, cordiform, the aedeagus more or less flattened.

Genus LIMNOPHILA Macquart; **Dendrolimnophila,** subgenus nov.

Antennae 16-segmented. Tibial spurs strong; claws small, simple. Venation (Fig. 44): *Sc* short, Sc_1 ending about opposite three-fifths to five-sixths the length of *Rs*, Sc_2 at or near its extreme tip; *Rs* long, subequal to its anterior branch; R_{1+2} and R_2 subequal; inner ends of cells R_4, R_5 and *1st* M_2 in approximate transverse alignment; cell M_1 lacking; cell *1st* M_2 long, in cases nearly equal to the distal section of vein M_{1+2}, in other specimens shorter; *m-cu* more than its own length beyond the fork of *M;* anterior arculus preserved. Male hypopygium (Fig. 47) with the posterior border of tergite, *9t*, produced caudad into a plate that forks into two glabrous lobes that are separated from one another by a U-shaped notch. Ninth sternite, *9s*, produced, the margin truncate. Basistyle, *b*, with a fingerlike lobe on mesal face at near midlength. Outer dististyle, *d*, a very slender sinuous glabrous rod, the tip unequally bidentate, the outer tooth low and triangular. Inner dististyle a very broad flattened blade, the outer third more narrowed, the tip obtuse. Phallosome, *p*, complex, consisting of paired divergent dusky blades that are tipped with short pale points. Outer portion of phallosome with a group of 10-12 needlelike points; besides this, a pair of pendant yellow structures that terminate in a dense cluster of more than a score of spinous points.

Type of subgenus.—Limnophila (*Dendrolimnophila*) *albomanicata* Alexander, 1945): Western Nearctic Region.

I had earlier referred this fly to the genus *Shannonomyia* Alexander, with a question. The discovery of the male sex shows that it has nothing to do with this latter genus, being more nearly allied to *Prionolabis* and *Phylidorea* in the genus *Limnophila*. The peculiar venational characters include the short subcosta and the loss of cell M_1 of the wings. The only known species is a small pale yellow fly, very conspicuous by the whitened tarsi.

Limnophila (*Dendrolimnophila*) *albomanicata* (Alexander, 1945).—Ilwaco, June 28, 1925 (*M*), type.

Limnophila (Phylidorea) aequiatra sp. nov.— Head and thorax black, heavily gray pruinose; antennae with scape black, pedicel and basal segments of flagellum yellow; femora yellow, the tips narrowly but abruptly black, the amount subequal on all legs; wings yellow, restrictedly patterned with brown: stigma oval, dark brown; *Rs* between three and four times as long as R_{2+3+4}.

♀. Length, about 11-12 mm.; wing, 10-11 mm.

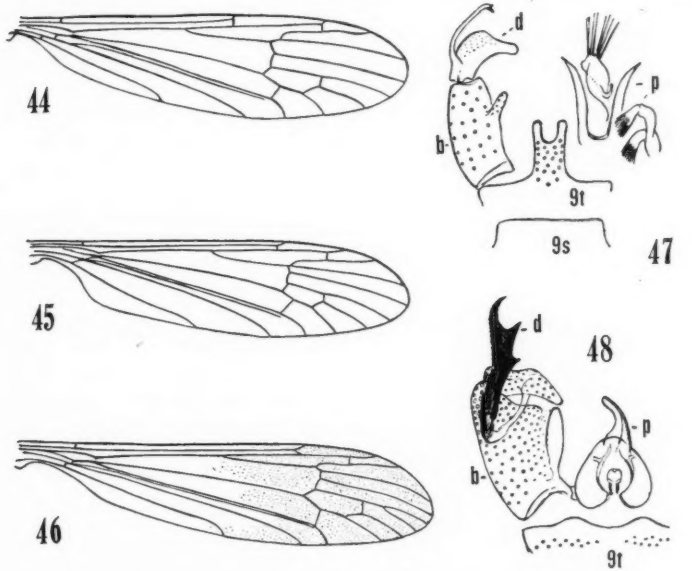
Rostrum dark gray; palpi black. Antennae with the scape black, sparsely pruinose; pedicel and basal segments of flagellum yellow, the outer segments passing into brown; basal flagellar segments oval, the outer ones elongate, with longer verticils. Head dark gray.

Pronotum and mesonotum black, rather sparsely dusted with gray, the praescutum especially so; posterior sclerites of notum and the entire pleura

dark gray. Halteres with stem yellow, knob infuscated. Legs with all coxae brownish yellow; trochanters yellow; femora yellow, the tips narrowly but abruptly black, the amount subequal on all legs, including approximately the outer eighth to tenth of the segments; in cases, a weak infuscation on proximal half of fore femora; tibiae and basitarsi yellow, the tips more narrowly blackened; outer tarsal segments black. Wings yellow, the prearcular and costal fields brighter yellow; a restricted brown pattern, including the oval dark brown stigma and very narrow seams over the cord and outer end of cell *1st* M_2; a conspicuous seam along vein *Cu* in cell *M;* vague and narrow seams over certain of the veins, including *2nd A* and those beyond cord; wing tip in cases vaguely darkened; veins brown, yellow in the brightened portions. Venation: *Rs* from three to four times as long as R_{2+3+4}; cell M_1 longer than its petiole; *m-cu* at near one-third to two-fifths the length of cell *1st* M_2.

Abdomen black, sparsely pruinose. Ovipositor with the genital shield and bases of the valves dark brown, the outer ends of the upcurved cerci horn-yellow.

Holotype, ♀, Galena Camp, Mt. Baker, 4,000 ft., August 11, 1947 (*C. P. Alexander*). *Paratopotypes,* ♀ ♀, August 11-14, 1947 (*C. P. Alexander*);



Figs. 44-48.—44. *Limnophila* (*Dendrolimnophila*) *albomanicata* Alexander, venation; 45. *Limnophila antennata* Coquillett, venation; 46. *Ulomorpha nigrodorsalis* sp. nov., venation; 47. *Limnophila* (*Dendrolimnophila*) *albomanicata* Alexander, male hypopygium; 48. *Limnophila antennata* Coquillet, male hypopygium. (Symbols: *b,* basistyle; *d,* dististyle; *p,* phallosome; *s,* sternite; *t,* tergite).

paratype, 1 ♀, Hood River Meadows, Mt. Hood, Oregon, 4,480 ft., July 17, 1947 (*C. P. Alexander*).

The only other regional member of the subgenus having the thorax entirely black, pruinose with gray, is *Limnophila* (*Phylidorea*) *olympica* sp. nov., which differs in the details of coloration, particularly of the legs. I feel that there are several allied species or well marked races in this particular section of the subgenus in the Pacific Northwest.

Limnophila (*Phylidorea*) *claggi* Alexander, 1930.—Mt. Baker: Swift Creek Trail, 4,500 ft., August 12, 1947 (*A*). Mt. Rainier: Altitude 4,700 ft., July 11, 1940 (*Townes*); Longmire Springs, 2,800 ft., July 20, 1922 (*M*), July 22, 1947 (*A*); Paradise Valley, 5,800 ft., August 11, 1946 (*A*). Ilwaco, May 5, 1918 (*M*); Snoqualmie Pass, July 3, 1940 (*Townes*).

Limnophila (*Phylidorea*) *euxesta* Alexander, 1924.—Olympic National Park: Olympic Hot Springs, 2,200 ft., August 7, 1947 (*A*). Mt. Rainier: Longmire Springs, June 1917 (*Dyar*), types; below Paradise Valley, 4,000 ft., August 11, 1946 (*A*); Narada Falls, August 16, 1917 (*M*).

Limnophila (*Phylidorea*) *flavipila* Doane, 1900.—Pullman, May 13, 1898 (*Doane*), types. Mt. Rainier: Longmire Springs, June 10-19, 1917 (*Dyar*).

Limnophila (Phylidorea) olympica sp. nov.—Thorax almost uniformly blackened, opaque by a gray pruinosity; antennal flagellum dark brown; knobs of halteres dark brown; femora obscure yellow basally, the tips blackened, very broadly so on the fore pair, very narrow on the remaining legs; wings yellow, restrictedly patterned with brown, chiefly as broad seams over the cord and along vein *Cu* in cell *M;* abdomen brownish black; cerci horn yellow.

♀. Length, about 12 mm.; wing, 11.8 mm.

Rostrum brownish black, pruinose; palpi black. Antennae with the scape black, pedicel and flagellum dark brown; flagellar segments subcylindrical, a little shorter than the verticils. Head clear light gray above, somewhat darker behind.

Thorax almost uniformly blackened, opaque by a gray pruinosity; praescutum with the central area a trifle more polished but not otherwise patterned; pseudosutural foveae black; dorsopleural region infuscated. Halteres with the stem light yellow, knob dark brown. Legs with the coxae brownish black, pruinose, the posterior pair somewhat paler apically; trochanters yellow; femora obscure yellow, the tips conspicuously blackened, very broad on the fore pair where only the proximal sixth is brightened, on the middle and hind femora the distal seventh or eighth is blackened; tibiae obscure yellow, the extreme base and tip darkened; basitarsi obscure yellow, the tip and remainder of the tarsi black. Wings (Fig. 41) yellow, the prearcular and costal fields clearer yellow; stigma oval, dark brown; narrow but conspicuous paler brown seams over the cord, outer end of cell *1st* M_2 and along vein *Cu* in cell *M;* still narrower indistinct seams over the longitudinal veins of outer two-thirds or more of wing; veins brownish black, those of the proximal third or more of wing yellowed. Venation: *Rs* moderately long, subequal to or a trifle longer

than cell *1st* M_2; petiole of cell M_1 more than one-half the cell; *m-cu* at near two-fifths the length of cell *1st* M_2.

Abdomen, including the genital shield, dark brown or brownish black; cerci horn-yellow.

Holotype, ♀, Deer Park, Olympic National Park, 5,400 ft., August 6, 1947 (*C. P. Alexander*).

The most similar regional species is *Limnophila* (*Phylidorea*) *aequiatra* sp. nov., which differs in details of coloration, as of the antennae and legs. Previously described species such as *L.* (*P.*) *flavipila* Doane and *L.* (*P.*) *snoqualmiensis* Alexander differ in the coloration of the body, legs and wings.

Limnophila (*Phylidorea*) *snoqualmiensis* Alexander, 1945.—Snoqualmie Pass, 3,000 ft., June 29, 1924 (*M*), types.

Limnophila bigladia Alexander, 1945.—Mt. Rainier: Dutch's Creek, Elbe, 1,200 ft., August 12, 1946 (*A*); Mazama Ridge, July 23, 1922 (*M*); Tipsco Lake, Chinook Pass, 5,440 ft., July 28-30, 1947 (*A*); Hudsonian zone, swept from low herbage around margin of upper lake; Yakima Park, 6,400 ft., August 3, 1947 (*A*).

Limnophila occidens Alexander, 1924.—Olympic National Park: Boulder Lake Trail, 3,500 ft., August 5, 1947 (*A*); Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Elbe, 1,200 ft., July 24, 1947 (*A*); Longmire Springs, 2,500 ft., amongst beds of skunk cabbage, devil's club, and associates, July 22, 1947, August 13, 1946 (*A*); Wonderland Trail, above White River, 4,800-5,700 ft., August 1, 1947 (*A*).

Limnophila tetonicola Alexander, 1945.—Mt. Rainier: Fairfax Trail, August 9, 1922 (*M*); Wonderland Trail, above White River, 5,500 ft., August 1, 1947 (*A*), flying in small swarms in patches of sunlight beneath mountain hemlock and fir.

Pilaria flava (Garrett, 1925).—Knightmore, August 9, 1919 (*M*).

Ulomorpha nigrodorsalis sp. nov.—Allied to *quinque-cellula;* size large (wing over 9 mm.); general coloration of thoracic notum blackened, the pleura and pleurotergite uniformly yellow; wings yellow, the stigma barely darkened; cell R_3 broadly sessile; cell M_1 present.

♂. Length, about 8.5-9 mm.; wing, 9.5-10 mm.

♀. Length, about 10-10.5 mm.; wing, 10 mm.

Rostrum yellow; palpi brown, passing into black. Antennae with scape obscure yellow, pedicel and flagellum dark brown; flagellar segments elongate-cylindrical, with long conspicuous verticils. Head above dark brown, pruinose.

Pronotum obscure yellow. Mesonotal praescutum with the disk covered by three confluent black stripes, the broad humeral and lateral portions yellow; scutal lobes extensively black, the central part and posterior portion of lobes more yellowed; scutellum brownish black; mediotergite brownish black, heavily pruinose, the sides, pleurotergite and pleura uniformly light yellow. Halteres with stem dirty white, clearer basally, knob infuscated. Legs with the

coxae and trochanters yellow; femora obscure yellow, the tips narrowly infuscated, the amount subequal on all legs; remainder of legs yellow, the terminal tarsal segments infuscated. Wings (Fig. 46) with a strong yellow ground, the stigma barely darkened; veins brown. Macrotrichia of cells including about the distal half of wing or basad to the general level of the origin of *Rs*. Venation: Cell R_3 broadly sessile; cell M_1 preserved; *m-cu* at or just before midlength of cell *1st* M_2. In one paratype, cell M_2 is open by the atrophy of *m* in one wing only.

Abdominal tergites (male) dark brown, the borders narrowly yellow, the sides somewhat more broadly so; sternites yellow; in male, eighth and ninth segments black, the styli obscure yellow; in female, abdominal tergites more uniformly darkened.

Holotype, ♂, Olympic Hot Springs, Olympic National Park, 2,200 ft., August 5, 1947 (*C. P. Alexander*). *Allotopotype*, ♀, pinned with type.

Paratopotypes, ♂ ♀, August 5-7, 1947; *paratypes*, 1 ♂, 1 ♀, Wonderland Trail, Mt. Rainier, 4,800 ft., August 1, 1947 (*M. M. Alexander*).

This fly is readily told from *Ulomorpha quinque-cellula* Alexander, 1920, by the coloration of the thorax. These two species are the only ones in the genus that have cell M_1 preserved.

Ulomorpha sierricola Alexander, 1918.—Olympic National Park: Olympic Hot Springs, 2,200 ft., August 7, 1947 (*A*). Mt. Rainier: specimen without more exact data, type; Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*). Mt. St. Helens: Toutle River, 2,000 ft., July 20, 1947 (*A*).

Hexatoma (*Eriocera*) *austera* (Doane, 1900) (*obscura* Williston, 1893, preoccupied).—Olympia, April 25, 1894 (*Kincaid*), types of *austera;* Seattle (ex *Kincaid*). Washington, without further data; part of type material of *obscura*.

Hexatoma (*Eriocera*) *eriophora* (Williston, 1893).—Washington, without further data, type; Merritt, August 6, 1942 (*Dolley*).

Hexatoma (*Eriocera*) *intrita* Alexander, 1943.—Walla Walla, 1,000 ft., May 28, 1938 (*Lane*), type.

Hexatoma (*Eriocera*) *scullen*i Alexander, 1943.—Rustic Inn, 7 miles west of Easton, near Kachess Lake, Wenatchee National Forest, August 13, 1946 (*A*); 1 ♂, resting on a reed at margin of stream.

ERIOPTERINI

Crypteria americana Alexander, 1917.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 15, 1947 (*A*). East Port Orchard, September 23-26, 1946 (*Fender*); Fort Lewis, Northeast Camp, 300 ft., November 22, 1945 (*Gurney*); Lewis & Clark State Park, September 28, 1946 (*Fender*).

Neolimnophila ultima (Osten Sacken, 1859), var.—Mt. Baker: Galena Camp, 4,000 ft., August 12, 1947 (*A*).

Cladura (*Cladura*) *macnabi* Alexander, 1944.—Barnes State Reservation, September 27, 1946 (*Fender*).

Cladura (*Cladura*) *oregona* Alexander, 1919.—Barnes State Reservation, September 27, 1946 (*Fender*); 15 miles north of Schine, September 22, 1946 (*Fender*); Twanoh State Park, September 22, 1946 (*Fender*).

Chionea nivicola Doane, 1900.—Pullman (Doane), types.

Lipsothrix fenderi Alexander, 1945.—East Port Orchard, September 23-26, 1946 (*Fender*); Lewis & Clark State Park, September 28, 1946 (*Fender*).

Lipsothrix nigrilinea (Doane, 1900).—Olympia, May 9, 1894 (*Kincaid*), type.

Gnophomyia (*Gnophomyia*) *tristissima* Osten Sacken, 1859.—Mill Creek, Walla Walla, July 2-6, 1922 (*M*). Doubtful record; see discussion earlier under Walla Walla.

Gonomyia (*Idiocera*) *brookmani* Alexander, 1944.—Naches, Yakima Valley, June 5, 1941 (*Brookman*), types.

Gonomyia (*Idiocera*) *coloradica* Alexander, 1920.—Mt. Rainier: Ohanapecosh Hot Springs, 1,900 ft., July 28-30, 1947 (*A*).

Gonomyia (*Idiocera*) *shannoni* Alexander, 1926.—Wawawai, July 8, 1920 (*Shannon*), types.

Gonomyia (*Lipophleps*) *cinerea* (Doane, 1900).—Pullman, August 10, 1898 (*Piper*), type (♀).

Gonomyia (*Gonomyia*) *aciculifera* Alexander, 1919.—Mt. Rainier: Elbe, 1,200 ft., August 12, 1946 (*A*); White River Camp, 4,400 ft., July 29, 1947, abundant (*A*).

Gonomyia (*Gonomyia*) *bihamata* Alexander, 1943.—Mt. Baker: Galena Camp, 4,000 ft., August 11, 1947 (*A*). Mt. Rainier: Chinook Pass, 5,400 ft., July 29, 1947 (*A*); Longmire Springs, 2,800 ft., July 22, 1947 (*A*); Paradise Valley, 5,500 ft., July 23, 1947 (*A*). This material is not quite typical but does not seem to warrant a new subspecific name.

Gonomyia (Gonomyia) filicauda bidenticulata subsp. nov.—Very close to typical *filicauda* Alexander, 1916, differing chiefly in one apparently important hypopygial character. Inner dististyle with the outer spine forking into two sharp points; in the typical form, the spine longer and entirely simple.

Holotype, ♂, Texaco Pond, Mt. Rainier, 2,000 ft., July 31, 1947 (*C. P. Alexander*). *Allotopotype*, ♀. *Paratopotypes*, 9 ♂ ♀.

Gonomyia (*Gonomyia*) *flavibasis* Alexander, 1916 (*tuberculata* Alexander, 1925).—Selah, Yakima Valley, July 15, 1941 (*Brookman*).

Gonomyia (Gonomyia) isolata sp. nov.—General coloration of praescutum brown, the lateral borders broadly yellow; rostrum orange; antennae black throughout; thoracic pleura yellow, variegated with reddish brown; wings grayish subhyaline, the prearcular and costal fields pale yellow; *Sc* short, Sc_1 ending a short distance before origin of *Rs;* male hypopygium with the flange of outer dististyle conspicuous, at outer end produced into an angular point; inner dististyle with the fasciculate setae placed on individual tubercles that are

separated by a U-shaped emargination; apical blade of aedeagus relatively small.

♂. Length, about 5.5 mm.; wing, 6.3 mm.

Rostrum orange-yellow; palpi black. Antennae black throughout; basal flagellar segments oval, outer ones passing into cylindrical; verticils conspicuous. Front orange; remainder of head gray, the center of occiput orange.

Pronotum and pretergites light yellow. Mesonotum brown, the praescutum with the humeral and lateral borders broadly light yellow; praescutal interspaces indicated behind; scutal lobes dark brown, the median area obscure yellow; mediotergite with a brownish gray hourglass-shaped central mark, the remaining anterolateral portions yellow; pleurotergite uniformly pale yellow. Pleura yellow, the ventral anepisternum and ventral sternopleurite dark reddish brown. Halteres uniformly darkened. Legs with the coxae and trochanters yellow; femora and tibiae obscure yellow, darkened outwardly, the tips dark brown; tarsi brown to brownish black. Wings (Fig. 49) grayish subhyaline, the prearcular and costal fields pale yellow; stigma oval, pale brown; veins brown, more brownish yellow in the brightened fields. Venation: *Sc* short, Sc_1 ending a short distance before origin of *Rs*, Sc_2 some distance from its tip; R_{2+3+4} long, arcuated at origin; *m-cu* close to fork of *M*.

Abdomen dark brown, the lateral tergal borders yellow, the posterior margins narrowly so; sternites and hypopygium yellow. Male hypopygium (Fig. 54) generally as in *bihamata*, differing especially in the structure of the inner dististyle, where the two fasciculate setae are placed on individual tubercles, separated from one another by a broad U-shaped emargination. In *bihamata*, both setae arise from the summit of a single stout tubercle. Flange of outer dististyle broad and conspicuous, at outer end produced into a short point or angle. From the typical form of *bihamata* (Northern and Central Rockies), it differs further in the details of both dististyles and in the small apical blade of the aedeagus, *p*.

Holotype, ♂, Deer Park, Olympic National Park, 5,400 ft., August 6, 1947 (*C. P. Alexander*).

The present fly is closest to *Gonomyia* (*Gonomyia*) *bihamata* Alexander, differing in the genitalic characters, as discussed above. The wide separation of the two fasciculate setae of the inner dististyle is not found in the allied species.

Gonomyia (*Gonomyia*) *percomplexa* Alexander, 1945.—Olympic Hot Springs: Below the springs, 2,000 ft., August 7, 1947 (*A*). Mt. Rainier: Nisqually Glacier Trail, 4,000 ft., July 23, 1947, swept from beds of *Claytonia* sp. (*A*); Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*); Wonderland Trail, above White River, 4,600-4,700 ft., August 1, 1947 (*A*).

Gonomyia (*Gonomyia*) *subcinerea* (Osten Sacken, 1859) (*obscura* Doane, 1900).—Pullman, June 22, 1898 (*Doane*), type of *obscura*.

Gonomyia (*Gonomyia*) *virgata* Doane, 1900.—Tokeland (*Doane*), type.

Rhabdomastix (*Sacandaga*) *leonardi* Alexander, 1930.—Mt. Rainier: Naches River, 1,900 ft., July 31, 1947 (*A*).

Rhabdomastix (*Sacandaga*) *subcaudata* Alexander, 1927.—Mt. Baker: Galena Camp, 4,000 ft., August 14, 1947 (*A*), swept from low beds of *Phyllodoce, Cassiope* and *Lutkea.*

Rhabdomastix (*Sacandaga*) *subfasciger* Alexander, 1927.—Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*).

Rhabdomastix (*Sacandaga*) *trichophora* Alexander, 1943.—Mt. Baker: Galena Ski Lodge, 3,800 ft., August 12, 1947 (*A*); Silver Fir Camp, along the Nooksack River, 1,990 ft., August 13, 1947 (*A*). Olympic National Park: Olympic Hot Springs, 2,000 ft., August 7, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., July 28, 1940 (*Townes*), types; July 22, 1947, August 10-13, 1946 (*A*); White River Camp, 4,400 ft., July 29, 1947 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*); smaller than normal but evidently identical.

Cryptolabis (*Cryptolabis*) *bisinuata* Doane, 1900.—Spokane, August 9, 1898 (*Doane*), types. Mt. Rainier: Naches River, 1,900 ft., July 28-31, 1947 (*A*); Naches, July 30, 1941 (*Brookman*).

Erioptera (*Empeda*) *alicia* Alexander, 1914.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13-15, 1947 (*A*).

Erioptera (Gonomyodes) tacoma sp. nov.—General coloration of mesonotum medium brown, the pleura and pleurotergite more yellowed; legs light brown; wings broad, milky subhyaline, the base more whitened; veins beyond cord with macrotrichia; vein R_3 longer than the petiole of the cell; vein R_2 atrophied or weakly preserved, in the latter case subequal to or longer than R_{3+4}; cell *1st* M_2 small, the veins beyond it straight; male hypopygium with the outer dististyle extended into a long straight spine; intermediate style nearly as long, at apex produced into a twisted dark-colored blade.

♂. Length, about 4.5 mm.; wing, 5.5 mm.

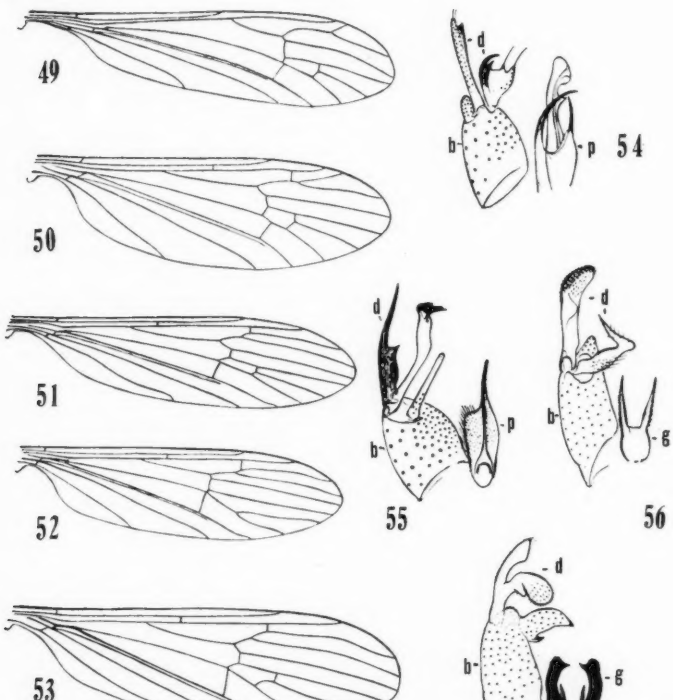
♀. Length, about 5-5.5 mm.; wing, 5.5 x 1.65 to 6 x 1.8 mm.

Rostrum and palpi brown. Antennae black. Head black, sparsely gray pruinose.

Mesonotum almost uniformly medium brown, the praescutum darker in front; pleura and pleurotergite more yellowed. Halteres short, whitish. Legs light brown. Wings (Fig. 50) broad, milky subhyaline, the base more whitened; stigmal area vaguely indicated; veins pale brown. Veins beyond cord with macrotrichia. Venation: Sc_1 ending just beyond the fork of *Rs*, Sc_2 preserved, shortly beyond midlength of *Rs;* R_2 apparently lacking in the type male, weakly preserved in the other specimens, subequal to or longer than R_{3+4}; vein R_3 extending nearly parallel to the outer end of vein R_{1+2}, longer than the petiole of cell R_3; cell *1st* M_2 small, the veins beyond it long, straight; *m-cu* about two-thirds its length beyond the fork of *M;* vein *2nd A* straight.

Abdomen, including hypopygium, dark brown. Ovipositor with the valves horn-yellow. Male hypopygium (Fig. 55) with the three dististyles, *d*, terminal, as in the subgenus. Outer dististyle a straight black rod, the basal

half stouter, the outer angle of the expanded portion produced into a long straight spine that is about as long as the base; intermediate style nearly as long, the basal half a cylindrical rod, the outer half slightly stouter, at apex produced into a flat twisted dark-colored blade, its tip acute; inner style slightly more than one-half as long as the latter, appearing as a slender pale rod, its tip obtuse. Phallosome, *p*, narrower than in allied species, the surface and lower margin of the dilated base with long dense setae or fimbriations; aedeagus slender.



Figs. 49-57.—49. *Gonomyia* (*Gonomyia*) *isolata* sp. nov., venation; 50. *Erioptera* (*Gonomyodes*) *tacoma* sp. nov., venation; 51. *Erioptera* (*Mesocyphona*) *melanderiana* Alexander, venation; 52. *Erioptera* (*Psiloconopa*) *recurva* sp. nov., venation; 53. *Erioptera* (*Psiloconopa*) *crassivena* sp. nov., venation; 54. *Gonomyia* (*Gonomyia*) *isolata* sp. nov., male hypopygium; 55. *Erioptera* (*Gonomyodes*) *tacoma* sp. nov., male hypopygium; 56. *Erioptera* (*Psiloconopa*) *recurva* sp. nov., male hypopygium; 57. *Erioptera* (*Psiloconopa*) *irata* sp. nov., male hypopygium. (Symbols: *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *p*, phallosome; *t*, tergite).

Holotype, ♂, White River Camp, Mt. Rainier, 4,400 ft., July 29, 1947 (*C. P. Alexander*). *Allotopotype*, ♀, with the type. *Paratype*, 1 ♀, found dead in spider's web, Longmire Springs, Mt. Rainier, 2,800 ft., July 24, 1947 (*C. P. Alexander*); 1 ♀, Foot of Mt. Edith Cavell, Jasper National Park, Alberta, 5,800 ft., August 21, 1947 (*C. P. Alexander*).

The only described members of the subgenus *Gonomyodes* Alexander, 1948, are *E.* (*G.*) *crickmeri* Alexander, 1948, and the subgenotype, *E.* (*G.*) *knowltonia* Alexander, 1948. The present fly is very similar to these in its general appearance, the latter differing very evidently in the structure of the male hypopygium and in slight differences in venation, especially of the radial field, where vein R_2 is shorter than vein R_{3+4}. There is a possibility that the paratype female from Alberta may prove to be nonconspecific but from present evidence the identification is correct.

Erioptera (*Mesocyphona*) *distincta* Alexander, 1912.—Pullman, June 15, 1918 (*M*).

Erioptera (*Mesocyphona*) *dulcis* Osten Sacken, 1877.—Mt. Rainier: Elbe, 1,200 ft., July 24, 1947 (*A*); Longmire Springs, 2,800 ft., July 30, 1922 (*M*); Ohanapecosh Hot Springs, 1,900 ft., July 24, 1947 (*A*); Paradise Park, 5,500 ft., August 1917 (*M*). Mica, July 14, 1918 (*M*); Montesano, July 19, 1917 (*M*); Moxee, June 11, 1941 (*Brookman*); Puget, July 4, 1925 (*M*); Union Gap, June 24, 1941 (*Brookman*).

Erioptera (*Mesocyphona*) *melanderiana* Alexander, 1944.—Mt. Baker: Galena Camp, 4,000 ft., August 10-14, 1947 (*A*); Swift Creek Trail, 4,300 ft., August 12, 1947 (*A*). Mt. Rainier: Mazama Ridge, July 23, 1922 (*M*), types; Paradise Park, August 1917 (*M*), types; 4,000-5,200 ft., August 11, 1946 (*A*), in wet boggy areas, chiefly grown with *Caltha leptosepala, Dodecatheon viviparum, Phyllodoce empetriformis,* and others; snow banks nearby and evidently the whole area had been snow covered only a few days earlier; Tipsoo Lake, 5,450 ft., July 28-30, 1947 (*A*). A characteristic species of the Hudsonian zone. Venation (Fig. 51).

Erioptera (*Erioptera*) *septemtrionis* Osten Sacken, 1859 (*subseptemtrionis* Alexander, 1920).—Naches, July 12, 1941 (*Brookman*); Pullman, Saint's Rest, June 1, 1924, June 11, 1921 (*M*).

Erioptera (*Symplecta*) *cana* (Walker, 1848) (All American records for *hybrida* Meigen, 1804, and *punctipennis* Meigen, 1818).—Mt. Rainier: Naches River, 1,900 ft., July 28, 1947 (*A*); White River Camp, 4,400 ft., July 29, 1947 (*A*); Yakima Park, 6,400 ft., July 29, 1947 (*A*), August 19, 1934 (*M*). Lake Colville, 1,900 ft., August 14, 1946 (*A*); Pullman, June 6, 1923 (*Argo*); Wawawai, May 30, 1921 (*M*).

Erioptera (*Trimicra*) *pilipes* (Fabricius, 1787), var.—Bellingham, May 31, 1917 (*Dyar*); Blynn, August 10, 1921 (*M*); Brinnon, on salt marsh, August 11, 1921 (*M*); Stanwood, June 30, 1924 (*M*).

Erioptera (*Psiloconopa*) *carbonipes* Alexander, 1929.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13-15, 1947 (*A*). Mt. Rainier: Elbe, 1,200 ft., July 24, 1947, August 10, 1946 (*A*). Mount Vernon, July 3, 1924 (*M*).

Erioptera (Psiloconopa) crassivena sp. nov.—General coloration brownish black, the praescutal interspaces sparsely pruinose to isolate three stripes; pseudosutural foveae black; knobs of halteres yellow; antennae and legs black; wings with a dusky tinge, more suffused in the stigmal region and along vein *Cu* in cell *M;* veins stout; vein *2nd A* gently sinuous on outer portion.

♀. Length, about 4.8 mm.; wing, 5.7 mm.

Rostrum and palpi black. Antennae black; basal flagellar segments short-oval, the outer ones passing through long-oval to cylindrical; segments shorter than the verticils. Head dark gray.

Thorax chiefly brownish black, the praescutum sparsely gray pruinose to leave the stripes of the ground; pseudosutural foveae and tuberculate pits black; postnotum and pleura more heavily pruinose. Halteres with stem weakly infuscated, the base restrictedly yellow, the knobs obscure yellow. Legs brownish black, the coxae weakly pruinose; fore trochanters brownish yellow. Wings (Fig. 53) with a weak dusky tinge, more suffused in the stigmal region and along vein *Cu* in cell *M;* veins brown, unusually stout, those comprising the anterior cord pale. Venation: Sc_2 nearly opposite one-third the length of *Rs;* cell *1st* M_2 closed, basal section of M_3 arcuated, about twice *m;* vein *2nd A* gently sinuous on its outer portion.

Abdomen black, the valves of the ovipositor light yellow.

Holotype, ♀, Silver Fir Camp, Mt. Baker, North Fork of the Nooksack River, 1,990 ft., August 13, 1947 (*C. P. Alexander*).

The most nearly allied species is *Erioptera* (*Psiloconopa*) *hygropetrica* Alexander, 1943, of the central Rocky Mountains in Colorado. This differs in details of coloration of the body and halteres and in slight venational features.

Erioptera (Psiloconopa) irata sp. nov.—Allied to *sparsa;* wings grayish yellow, with a restricted brown pattern; male hypopygium with the caudal margin of the tergite produced into two compressed-flattened plates, separated by a U-shaped notch, the lower margins of the plates toothed; outer dististyle with its inner arm a broad blade that is microscopically spiculose; inner dististyle large and pale, terminating in a spinous point, with a further point on the lower margin near base; outer gonapophyses appearing as stout gently curved blackened rods, the inner margin before apex with an upturned point or beak.

♂. Length, about 4.5-5 mm.; wing, 5-6 mm.

♀. Length, about 5.5 mm.; wing, 6.2 mm.

Rostrum and palpi black. Antennae with basal segments testaceous yellow, the flagellar segments pale brown to brown; flagellar segments suboval or with the lower face slightly produced; longest verticils unilaterally arranged on the dorsal face, about one-half longer than the segments. Head brownish gray.

Pronotum brown, the scutellar lobes and pretergites testaceous yellow. Mesonotum chiefly brownish gray, the praescutum scarcely patterned with darker; pseudosutural foveae and tuberculate pits black; posterior portions of

scutal lobes and the parascutella paler. Pleura grayish brown to gray. Halteres uniformly pale yellow. Legs with the coxae brownish gray; trochanters yellow; femora obscure yellow, the tips darkened; tibiae pale brown, narrowly darkened at both ends; tarsi passing into darker brown. Wings with the ground grayish yellow, patterned with brown, including seams over the cord and crossveins and as marginal spots at ends of the longitudinal veins, largest in the costal and outer radial fields; one to few dark spots in basal part of cell Cu_1; dusky seams over most veins beyond cord and in the Anal cells, especially *1st A;* veins obscure yellow, brown in the clouded portions. Venation: Sc_2 opposite or just beyond midlength of *Rs;* cell *1st* M_2 moderately long, basal section of M_3 about twice *m;* both the allotype and paratype show a short spur on vein *2nd A* beyond midlength, jutting outward into cell *2nd A;* the holotype does not show this character.

Abdomen, including hypopygium, dark brown. Male hypopygium (Fig. 57) with the tergite, *9t,* narrowed outwardly, extended into a compressed blade on either side of a U-shaped median notch, the lower margin of the blade serrulate. Outer dististyle, *d,* with two primary arms, the outer one glabrous, slightly expanded outwardly, the outer face with microscopic appressed serrulations; outer apical angle with a few setae; inner arm a broad blade, the margin and surface with microscopic spiculose points; near base of arm with a strong blackened lobe. Inner dististyle a large pale structure that terminates in an acute point; lower margin at base with an acute spinous projection; vestiture yellow. Outer gonapophyses, *g,* appearing as stout, gently curved rods, the outer surface near apex microscopically roughened, the inner margin near apex produced into a slightly upcurved spinous beak or point; inner apophyses appearing as strongly blackened spikes at base of the major outer ones.

Holotype, ♂, Peavine Ridge, Yamhill County, Oregon, Station 1, 210 ft., July 26, 1946 (*K. M. Fender*). *Allotopotype,* ♀, April 23, 1946 (*Fender*). *Paratypes,* 1 ♂, Happy Valley, McMinnville, Oregon, April 14, 1946 (*Fender*); ♂ ♂, Silver Fir Camp, Mt. Baker, 1,990 ft., August 13, 1947 (*C. P. Alexander*), not uncommon along the Nooksack River; ♂, Longmire Springs, Mt. Rainier, 2,800 ft., August 23, 1947 (*C. L. Remington*).

The most similar described species are *Erioptera* (*Psiloconopa*) *polycantha* Alexander and *E.* (*P.*) *sparsa* Alexander, 1919, which differ conspicuously in all details of structures of the male hypopygia.

Erioptera (*Psiloconopa*) *margarita* Alexander, 1919.—Mt. Rainier: Longmire Springs, 2,800 ft., August 10, 1946, July 1947 (*A*); White River Camp, 4,400 ft., July 29, 1947 (*A*).

Erioptera (*Psiloconopa*) *megarhabda* (Alexander, 1943).—Mt. Baker: Silver Fir Camp, 1,990 ft., August 15, 1947 (*A*). Mt. Rainier: Elbe, near Alder Lake, 1,200 ft., July 24, 1947, August 12, 1946 (*A*).

Erioptera (*Psiloconopa*) *polycantha* Alexander, 1945.—Mt. Rainier: Elbe, near Alder Lake, 1,200 ft., August 12, 1946 (*A*). Quilcene, July 24, 1917 (*M*), type.

Erioptera (*Psiloconopa*) *rainieria* Alexander, 1943.—Mt. Baker: Galena

Camp, 4,000 ft., August 9-14, 1947 (*A*). Mt. Rainier: Altitude 5,000 ft., July 14, 1940 (*Townes*), types; Alta Vista, July 29, 1922 (*M*); Indian Henry, August 2, 1922 (*M*); Paradise Valley, 5,560 ft., July 27, 1922 (*M*), August 11, 1946 (*A*); Tipsoo Lake, 5,440 ft., July 28-30, 1947 (*A*). In the northern part of its range the species is characteristic of the Hudsonian zone; at the southern end, at Sequoia National Park, California, it is Canadian.

Erioptera (Psiloconopa) recurva sp. nov.—Mesonotum brownish gray, unpatterned; antennae with scape and pedicel brownish black, the flagellum pale brown; wings subhyaline, unpatterned; cell M_2 open by the atrophy of *m;* vein *2nd A* short and straight; male hypopygium with the outer dististyle an elongate blackened structure, the outer half more enlarged, at near midlength produced into a low lobe or flange; inner dististyle a blackened rod, at apex bent strongly backward into a powerful spine; gonapophyses consisting of an oval base that forks into two long slender blackened spinous arms, the inner one with its inner margin microscopically toothed.

♂. Length, about 4.6 mm.; wing, 5 mm.

Rostrum dark brown; palpi black. Antennae with scape and pedicel brownish black, flagellum pale brown; flagellar segments subcylindrical, with long verticils. Head brownish gray.

Pronotum brownish gray; scutellum and anterior pretergites yellowed. Mesonotal praescutum brownish gray, unpatterned; pseudosutural foveae pale, tuberculate pits darker; posterior sclerites of notum more chestnut brown; lateral borders of mediotergite and much of the pleurotergite more yellowed. Pleura light brown, sparsely pruinose. Halteres pale. Legs with the coxae and trochanters pale yellow; remainder of legs yellow, with only the outer tarsal segments darker. Wings (Fig. 52) subhyaline; veins pale brown, more yellowed at the wing base. Venation: *Rs* subequal in length to Sc_1; R_2 faint, subequal to R_{2+3}; cell M_2 open by atrophy of *m; m-cu* close to fork of *M;* vein *2nd A* short and straight, the Anal vein thus strongly divergent.

Abdomen dark brown, including the hypopygium, the appendages of the latter blackened. Male hypopygium (Fig. 56) with the dististyles, *d,* slightly subapical in position; outer dististyle a long strong blackened structure, the outer half more enlarged to form an elongate head that is provided with rows of abundant close-set spines; at near midlength with a low lobe or flange on outer margin. Inner dististyle shorter, blackened, at apex bent strongly backward into a powerful spine; outer surface of stem with abundant long setae, the recurved spine with fewer shorter setae on outer face. Gonapophyses, *g,* black, the base oval, bearing two long slender spines, the outer smooth, the inner a trifle longer, its inner margin with microscopic spines, those near base larger and more separated.

Holotype, ♂, Near Alder Lake, Elbe, foot of Mt. Rainier, 1,200 ft., August 12, 1946 (*C. P. Alexander*). *Paratopotypes,* ♂ ♂.

The most similar regional species is *Erioptera* (*Psiloconopa*) *bisulca* Alexander, 1948, of the Sierra Nevadas of central California. This differs evident-

ly in the structure of the male hypopygium, including both dististyles and the gonapophyses.

Erioptera (*Psiloconopa*) *shoshone* Alexander, 1945.—Mt. Rainier: Naches River, 1,900 ft., July 28-31, 1947 (*A*); swept from low herbage along the stream.

Erioptera (*Hesperoconopa*) *dolichophallus* Alexander, 1948.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13-15, 1947 (*A*), swept from vegetation along the Nooksack River. Mt. Rainier: Longmire Springs, 2,800 ft., August 10-14, 1946 (*A*); White River Camp, 4,400 ft., August 1, 1947 (*A*), abundant on river bar vegetation.

Ormosia (*Rhypholophus*) *bicuspidata* Alexander, 1944.—Castle Rock, August 28, 1921 (*M*), types; Twanoh State Park, September 22, 1946 (*Fender*).

Ormosia (*Rhypholophus*) *bifidaria* Alexander, 1919.—Mt. Baker: Galena Camp, 4,000 ft., August 9, 1947 (*A*). Mt. Rainier: Chinook Pass, 5,400 ft., July 29-30, 1947 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*). Characteristic of the Hudsonian zone.

Ormosia (*Rhypholophus*) *fumata* (Doane, 1900).—Mt. Rainier: Longmire Springs, 2,800 ft., August 10-11, 1946 (*A*).

Ormosia (*Rhypholophus*) *paradisea* Alexander, 1920 (*garretti* Alexander, 1926).—Mt. Rainier: Paradise Valley, 5,000-6,000 ft., July 29, 1919 (*C. L. Fox*), type of *paradisea;* August 1917 (*M*); 5,600 ft., July 23, 1947 (*A*); Mazama Ridge, July 23, 1922 (*M*); Sluiskin, July 28, 1922 (*M*); Tipsoo Lake, 5,440 ft., July 28-30, 1947 (*A*); Van Trump, July 21, 1922 (*M*); White River, July 20, 1924 (*M*); Yakima Park, 6,400 ft., July 29, 1947 (*A*). Characteristic of the Hudsonian zone.

Ormosia (*Rhypholophus*) *suffumata* Alexander, 1943.—Mt. Baker: Above Galena Creek, 4,300 ft., August 11, 1947 (*A*).

Ormosia (*Ormosia*) *absaroka* Alexander, 1943.—Mt. Rainier, Tipsoo Lake, 5,450 ft., July 28-30, 1947 (*A*).

Ormosia (*Ormosia*) *albertensis* Alexander, 1933.—Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Altitude 4,700 ft., August 13, 1940 (*Townes*), presumably below Paradise Valley; Wonderland Trail, above White River, 5,700 ft., August 1, 1947 (*A*). The fly is very close to the eastern *Ormosia* (*Ormosia*) *mesocera* Alexander, 1917.

Ormosia (Ormosia) cerrita sp. nov.—Allied to *unicornis;* general coloration dark brown; antenna short; wings with a brownish tinge, the stigma still darker; male hypopygium with the margin of the tergite before the median spatula broadly blackened and fimbriate; outer dististyle conspicuously three-branched, the short outer branch bispinous at apex, the two inner branches simple, forking close to base of style.

♂. Length, about 4.5 mm.; wing, 4.7 mm.; antenna, about 1 mm.

Rostrum and palpi brown. Antenna brown throughout, short, as shown by the measurements; flagellar segments oval, with very long verticils, on the

more basal segments the longest fully three times the segments; verticils of outer segments very small to lacking. Head dark brown.

Pronotum light brown, the scutellum and anterior pretergites more testaceous yellow. Mesonotal praescutum and scutum chiefly dark brown, the posterior sclerites a trifle paler. Pleura chiefly medium brown. Halteres yellow. Legs with the coxae and trochanters light yellow; remainder of legs brownish yellow, the outer tarsal segments brownish black. Wings (Fig. 58) with a brownish tinge, the stigma still darker brown; veins brown. Venation: Sc_1 ending about opposite R_2, Sc_2 nearly opposite midlength of Rs; R_{2+3+4} about one-half longer than the basal section of R_5; cell M_2 open by atrophy of basal section of M_3; *m-cu* just before the fork of *M;* vein *2nd A* nearly straight, pale and feebly sinuous on outer third.

Abdomen, including hypopygium, dark brown. Male hypopygium (Fig. 64) with the margin of the tergite, *9t*, before the median spatula broadly blackened and margined with short black setulae; spatula narrowed basally. Outer dististyle, *d*, conspicuously three-branched, the outer branch shortest and stoutest, bispinous at apex; other branches simple, subequal in length, forking close to base of style. Inner dististyle a long narrow paddle, on outer margin at near midlength bearing a slender spine. Gonapophyses, *g*, unequally bispinous, the longest or inner branch slender, sinuous.

Holotype, ♂, Silver Fir Camp, Mt. Baker, North Fork of the Nooksack River, 1,990 ft., August 13, 1947 (*C. P. Alexander*).

The closest allies are *Ormosia* (*Ormosia*) *tricornis* Alexander, 1948, and *O.* (*O.*) *unicornis* Alexander, mss., which differ among themselves in the characters of the male hypopygia, especially the structure of the outer dististyles.

Ormosia (*Ormosia*) *curvata* Alexander, 1924.—Olympia, April 16, 1894 (*Kincaid*).

Ormosia (*Ormosia*) *decussata* Alexander, 1924.—Mt. Baker: Nooksack Camp, 1,200 ft., August 13, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 10-13, 1946 (*A*). East Port Orchard, September 23, 1946 (*Fender*); Kachess Lake, August 13, 1946 (*A*).

Male hypopygium (Fig. 61) with the tergite broader than in *longicornis* (Doane), the pale median membranous area extensive. Inner dististyle, *d*, more or less bilobed, the basal portion more expanded. Gonapophyses, *g*, very strong and powerfully developed, appearing as dilated basal plates that are narrowly united at the midline, the elongate spines sinuous, very gradually narrowed to the acute tips, in slide mounts the latter decussate across the midline. See discussion under *longicornis*.

Ormosia (*Ormosia*) *fusiformis* (Doane, 1900) (*divexa* Doane, 1908).—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 10-13, 1946 (*A*). East Port Orchard, September 23-26, 1946 (*Fender*).

The type of *divexa* is a female from Keyport, Washington, July 1905 (*Doane*). I examined this type in San Francisco in 1946 and consider it to

represent the present fly. The right wing of this type is missing. Cell *1st* M_2 is closed, as in *fusiformis*, not opening into cell *2nd* M_2 as stated by Doane, *m* being present though faint, straight, the basal section of M_3 a trifle longer and more arcuated; *m-cu* at fork of *M*. The antennae are uniformly light brown.

Ormosia (*Ormosia*) *hispa* Alexander, 1945.—Puget, July 4, 1925 (*M*), type.

Ormosia (*Ormosia*) *longicornis* (Doane, 1908).—Keyport, July 1905 (*Doane*), type. Although allied to *decussata* Alexander, the two flies seem certainly to be distinct. I studied the type of the present species in San Francisco in 1946 and made notes and rough figures of genitalic structures which I am including in the present report. Male hypopygium (Fig. 63) shows differences in the ninth tergite, *9t;* dististyles, *d*, and the gonapophyses, *g*, which are more slender and more angular in the present fly. See discussion under *decussata* (Fig. 61).

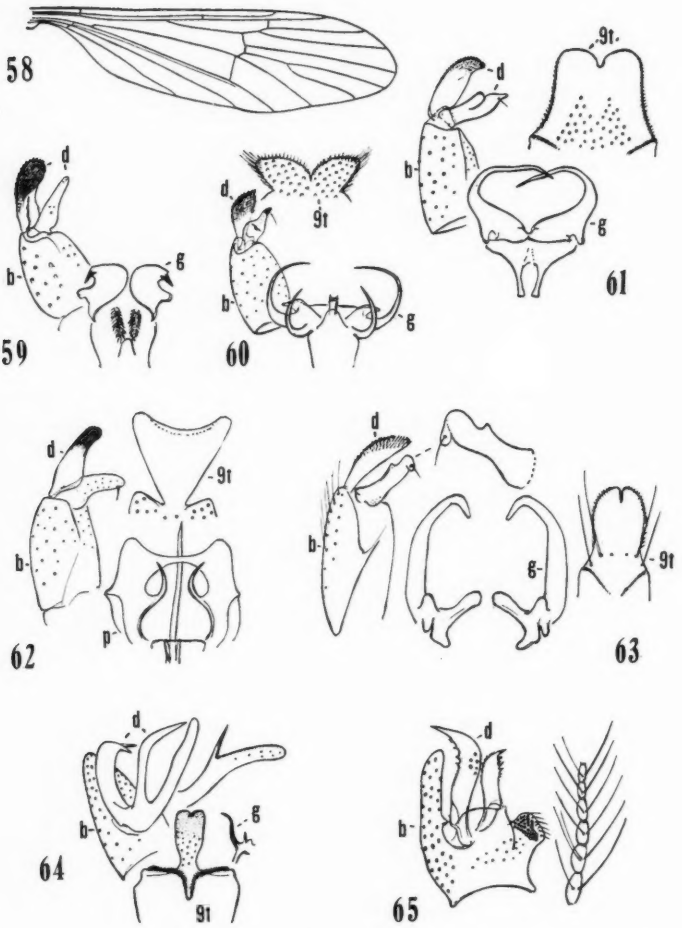
Ormosia (*Ormosia*) *manicata* (Doane, 1900) (*deviata* Dietz, 1916, *fuscopyga* Alexander, 1924).—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13, 1947 (*A*). Mt. Rainier: Ohanapecosh Hot Springs, 2,000 ft., July 30, 1947 (*A*). Everett, June 19, 1920 (*M*); Lewis & Clark State Park, September 28, 1946 (*Fender*).

Ormosia (*Ormosia*) *onerosa* Alexander, 1943.—Mt. Baker: Galena Camp, 4,000-4,300 ft., August 10-14, 1947 (*A*). Mt. Rainier: Cayuse Pass, 4,600 ft., July 30, 1947 (*A*); Nisqually Glacier Trail, 4,000 ft., July 23, 1947 (*A*); Paradise Valley, 5,600 ft., July 23, 1947, August 11, 1946 (*A*); Tipsoo Lake, 5,440 ft., July 28-30, 1947 (*A*); Wonderland Trail, below Yakima Park, 5,800-6,000 ft., August 1, 1947 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*). One of the commonest and most characteristic small crane-flies of the Hudsonian zone.

Ormosia (*Ormosia*) *pugetensis* Alexander, 1944.—Puget, July 4, 1925 (*M*), type. Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*); Wonderland Trail, above White River, 4,800 ft., August 1, 1947 (*A*).

The male hypopygium (Fig. 60) has not been adequately described. -Tergal lobes, *9t*, large but low and divergent, separated by a very narrow median split; margins of lobes with fimbriations, longest and most conspicuous at the outer angles; dorsal surface of tergum with very long conspicuous setae. Outer dististyle, *d*, broad, the distal two-thirds of outer face with rows of microscopic scale-like setae. Inner dististyle darkened, broad on basal half, thence narrowed into the blackened apex, before tip with one seta of unusual length. Phallosome, *p*, with a transverse central plate that is produced at either end into two strong spines and a beak-like smaller lobe; longest spine or arm unusually long and very slender; shorter spine stouter and about two-thirds as long as the outer one.

Ormosia (*Ormosia*) *subcornuta* Alexander, 1920.—Mt. Rainier: Alder Lake, near Elbe, 1,200 ft., July 24, 1947, August 10, 1946 (*A*).



Figs. 58-65.—58. *Ormosia* (*Ormosia*) *cerrita* sp. nov., venation; 59. *Ormosia* (*Ormosia*) *albertensis* Alexander, male hypopygium; 60. *Ormosia* (*Ormosia*) *pugetensis* Alexander, male hypopygium; 61. *Ormosia* (*Ormosia*) *decussata* Alexander, male hypopygium; 62. *Ormosia* (*Ormosia*) *triangularis* sp. nov., male hypopygium; 63. *Ormosia* (*Ormosia*) *longicornis* Doane, male hypopygium; 64. *Ormosia* (*Ormosia*) *cerrita* sp. nov., male hypopygium; 65. *Molophilus* (*Molophilus*) *kulshanicus* sp. nov., male hypopygium, antenna. (Symbols: *b*, basistyle; *d*, dististyle; *g*, gonapophysis; *p*, phallosome; *t*, tergite).

Ormosia (Ormosia) triangularis sp. nov.—Belongs to the *flaveola* group; general coloration of thorax reddish brown to brownish gray; head uniformly gray; wings with a weak brownish tinge, the stigma slightly darker; male hypopygium with the tergite produced into a large triangular plate, its caudal border gently concave; outer dististyle a stout simple lobe, the blackened apex microscopically serrulate; phallosome consisting of a plate on either side, connected with one another by a narrow bridge across the posterior border; mesal edge of either plate produced into a strong spine.

♂. Length, about 4.5 mm.; wing, 5 mm.

♀. Length, about 5.5-5.8 mm.; wing, 5.5-6 mm.

Rostrum and palpi brownish black. Antennae short; scape testaceous yellow to brown, pedicel and flagellum dark brown or brownish black; flagellar segments oval, with long verticils. Head uniformly gray.

Pronotum brown, the pretergites yellow. Mesonotal praescutum reddish brown, the broad median area more brownish gray; pseudosutural foveae black; posterior sclerites of notum brownish gray, pleurotergite more yellowed. Pleura brownish gray. Halteres obscure yellow, clearer yellow at base of stem, knob weakly infuscated. Legs with the coxae and trochanters yellow; remainder of legs pale brown to brown, the outer tarsal segments darker. Wings with a weak brown tinge, the stigma a little darker brown; prearcular and costal fields a little more yellowed; veins pale brown. Macrotrichia of cells abundant, distributed virtually over the entire wing. Venation: Cell M_2 open by the atrophy of *m*.

Abdomen dark brown, the hypopygium a trifle paler. Male hypopygium (Fig. 62) distinctive. Ninth tergite, *9t*, with the apical appendage roughly an equilateral triangle in outline, the basal connection unusually narrow, expanded outwardly, the caudal margin gently concave, with restricted pale membrane; appendage microscopically roughened, the setae abundant but small and inconspicuous. Outer dististyle, *d*, a stout simple lobe, narrowed outwardly, the distal half blackened, tip obtuse, microscopically serrulate. Inner dististyle nearly as long and not greatly dissimilar in outline, at tip with a single strong modified seta. Phallosome, *p*, very distinct, consisting of a plate on either side, united across the posterior border by a very narrow bridge, behind which is a major lacuna; mesal margin of either plate produced caudad into a long sinuous spine. Aedeagus slender, the tip acute.

Holotype, ♂, East Port Orchard, September 25, 1946 (*K. M. Fender*). *Allotopotype*, ♀. *Paratopotype*, 1 ♀.

This fly is very different from all other members of the *flaveola* group so far made known. It is perhaps most similar to *Ormosia* (*Ormosia*) *absaroka* Alexander, which has the male hypopygium, particularly the tergite, outer dististyle and phallosome, all quite different. For a discussion of the various groups of *Ormosia* that have cell M_2 open by the atrophy of crossvein *m*, as they occur in North America, a paper by the writer may be consulted (Alexander, Amer. Midl. Nat., 30: 755; 1943).

Ormosia (*Ormosia*) *upsilon* Alexander, 1946.—Barnes State Park, Sep-

tember 27, 1946 (*Fender*); East Port Orchard, September 3-25, 1946 (*Fender*).

Molophilus (*Molophilus*) *colonus* Bergroth, 1888 (*comatus* Doane, 1900). —Mt. Rainier: Naches River, 1,900 ft., July 31, 1947 (*A*). Entiat, July 26, 1919 (*M*); Knightmore, August 9, 1919 (*M*); Pullman (*Doane*), Seattle (*Kincaid*), types of *comatus*.

Molophilus (*Molophilus*) *distilobatus* Alexander, 1945.—Olympic National Park: Deer Park, 5,400 ft., August 6, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., July 22, 1947 (*A*), August 10-13, 1946 (*A*). Ilwaco, May 5, 1918 (*M*).

Molophilus (*Molophilus*) *harrisoni* Alexander, 1945.—Mt. Rainier: Elbe, Alder Lake, 1,200 ft., August 12, 1946 (*A*); Naches River, 1,900 ft., July 28-31, 1947 (*A*).

Molophilus (Molophilus) kulshanicus sp. nov.—Belongs to the *gracilis* group, *pubipennis* subgroup; size large (wing, male, over 5 mm.); general coloration of body brownish black, obscured by a sparse pruinosity; antennae (male) less than one-half the length of body, black throughout; flagellar segments with very long verticils, the erect pale pubescence of the more proximal segments less than one-half the length of the segments; wings subhyaline, with a brown seam in cell *M* adjoining *Cu;* male hypopygium black; outer dististyle a broad flattened blade that is about one-fifth as wide as long, the lower margin with five or six acute points; phallosomic plate with microscopic setulae.

♂. Length, about 4.8-5 mm.; wing, 5.3-5.5 mm.; antenna, about 1.30-1.35 mm.

Rostrum and palpi black. Antennae (Fig. 65) moderately long, more than one-fourth the length of the body or wing, black throughout; basal flagellar segments subcylindrical or with the lower face a trifle produced, the outer segments more oval; longest verticils of the basal flagellar segments approximately twice the segments, these becoming progressively shorter on the outer segments; pale erect pubescence of the basal segments abundant, less than one-half the segments. Head uniform gray.

Pronotum infuscated medially, the scutellum light yellow. Mesonotum brownish black, the color dulled by a sparse pruinosity; posterior margins of scutal lobes and the parascutella obscure yellow; postnotum blackened, the suture narrowly pale. Pleura black, pruinose to produce a plumbeous appearance; dorsopleural region obscure yellow. Halteres uniformly yellow. Legs with the coxae yellowish brown to light brown; remainder of legs black. Wings broad, subhyaline; a brown seam in cell *M* adjoining vein *Cu;* veins and macrotrichia light brown, R_{4+5} and *Cu* darker brown. Venation: R_2 lying just distad of level of *r-m;* petiole of cell M_3 nearly twice *m-cu;* vein *2nd A* long and sinuous, ending about opposite one-fourth the length of the petiole of cell M_3.

Abdomen, including hypopygium, black. Male hypopygium (Fig. 65) with the ventromesal lobe of basistyle, *b*, provided with a triangular group of about 35 strong black spinous points, the marginal vestiture appearing as long setae, there being no conspicuous intermediate types of setae. Outer dististyle, *d*, a strong flattened blade, curved to the long straight apical spine, the greatest breadth about one-fifth the length; lower or concave margin with about five or six acute points; outer margin entirely smooth, the surface at midlength with about six setae. Inner dististyle smaller, with appressed spines on outer margin of distal half and coarser more erect ones on the lower face, some of the latter larger and coarser. Phallosomic plate with microscopic setulae.

Holotype, ♂, Swift Creek Trail, Mt. Baker, 4,300 ft., August 12, 1947 (*C. P. Alexander*). *Paratypes*, ♂, Chinook Pass, Mt. Rainier, 5,100 ft., July 29, 1947 (*C. P. Alexander*); Tilly Jane Creek, Mt. Hood, Oregon, 5,600 ft., July 18, 1947 (*C. P. Alexander*); ♂, Hood River Meadows, Mt. Hood, Oregon, 4,480 ft., July 17, 1947 (*C. P. Alexander*).

The closest relative of the present fly appears to be *Molophilus* (*Molophilus*) *paulus* Bergroth, 1888, which is distinguished by the smaller size, pale coloration, length and vestiture of the antennae, and in the details of structure of the male hypopygium.

Molophilus (*Molophilus*) *nitidulus* Alexander, 1944.—Almota, May 20, 1923 (*M*), types.

Molophilus (*Molophilus*) *nitidus* Coquillett, 1905.—Seattle (ex *Kincaid*); Sultan, June 9, 1919 (*M*); Vancouver, July 7, 1917 (*M*).

Molophilus (*Molophilus*) *paulus* Bergroth, 1888.—Mt. St. Helens: Spirit Lake, 3,200 ft., July 21, 1947 (*A*). Ilwaco, May 5, 1918 (*M*). In some specimens the pale pubescence of the flagellar segments is shorter and less conspicuous than in others yet seem to be conspecific. It is best distinguished from *spiculatus* by the antennal structure and vestiture.

Molophilus (*Molophilus*) *perflaveolus* Alexander, 1918.—Mt. Baker: Silver Fir Camp, 1,990 ft., August 13, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 10-13, 1946; Ohanapecosh Hot Springs, 1,900 ft., July 25, 1947 (*A*); White River Camp, 4,400 ft., July 29, 1947 (*A*). Mt. St. Helens: Timberline, 4,300 ft., July 21, 1947 (*A*). Everett, July 4-6, 1924 (*M*); Ilwaco, June 28, 1925 (*M*); Kachess Lake, August 13, 1946 (*A*); Nasel River, July 2, 1925 (*M*); Quilcene, July 24, 1917 (*M*).

Molophilus (*Molophilus*) *rainierensis* Alexander, 1943.—Olympic National Park: Boulder Lake Trail, 2,200 ft., August 6, 1947 (*A*), in skunk cabbage association; Deer Park, 5,400 ft., August 6, 1947 (*A*), very abundant. Mt. Rainier: Longmire Springs, 2,800 ft., July 20, 1922 (*M*).

Molophilus (*Molophilus*) *spiculatus* Alexander, 1918.—Mt. Baker: Galena Camp, 4,000 ft., August 12-14, 1947 (*A*); Galena Ski Lodge, 3,800 ft., August 10, 1947 (*A*). Mt. Rainier: Longmire Springs, 2,800 ft., August 23, 1947 (*Remington*); Yakima Park, 6,400 ft., July 27, 1947 (*A*).

Molophilus (*Molophilus*) *subnitens* Alexander, 1944.—Valleyford, May 29, 1921 (*M*), types.

The Freshwater Isopods of the Genus Lirceus (Asellota, Asellidae)

Leslie Hubricht
912 Main St., Danville, Virginia

J. G. Mackin
Texas A & M Research Foundation, Grande Isle, Louisiana

In the genus *Asellus* we have, in the first and second pleopoda of the male, characters which can be relied upon to distinguish the species, but in *Lirceus* these appendages are so similar in different species that they are, with one exception, useless as a means of separation. This is not because the species of *Lirceus* are less distinct than *Asellus*, but requires that the animal as a whole be studied rather than a single appendage. To an experienced observer the various species are easily distinguished in the field by those subtile differences in form and color which are almost impossible to describe. Difficulties begin when one brings specimens into the laboratory and attempts to define the differences. The commonest cause of difficulty is depauperate specimens. Under adverse conditions the animals are stunted, the gnathopoda do not develop their processes, and the uropoda remain in juvenile form. When this depauperization is extreme the collection cannot be determined, but must be assumed to belong to the species in the range of which it was found.

The isopods discussed herein have, in the past, been treated under the generic name *Mancasellus* Harger, rather than the prior *Lirceus* of Rafinesque. Rafinesque's description, though very poor, is sufficient to determine the genus. Since only one species of asellid occurs in the vicinity of Lexington, Kentucky, the type locality, there is no doubt as to the identity of Rafinesque's species.

An Evaluation of the Characters used to Distinguish Species in Lirceus

Because appendages and other structures of taxonomic value are so much better developed in males than in the females, determinations can more advantageously be made from them. Therefore, in the following discussion and in the descriptions the females have been ignored, and of the males only those well developed are used as a basis for description.

General body form.—Young specimens about 1/4 inch long are about 3.5 times as long as broad. In some species they become proportionately broader as they grow older until they may be a little less than twice as long as broad, so that this is a useful character in fully developed specimens but useless with depauperates. Whether or not the body is contracted or relaxed affects these

proportions and it was found that they could be expressed better by the pleotelson alone.

Color.—The basic color pattern is quite similar in all the species. There is a median zone which may or may not be mottled, on each side of this is a wide lateral zone which is mottled with yellowish and in some species has a dark border on both sides giving the animal the appearance of having four longitudinal bands, and there is a usually lighter marginal zone. Although some of the species are rather distinctly colored the differences are difficult to describe and must be seen to be really understood.

Head.—In some species the head is incised but in others it is entire; in still others both conditions occur with occasional intermediates.

Antennae.—The differences in the antennae between species are so slight and the age differences so great that they are useless as taxonomic characters and have not been used in this paper.

Mouth Parts.—There are no specific peculiarities in the mouth parts other than those pertaining to the mandibulary palp. Most species are without a palp but some have a three-jointed palp and in others the structure has only one joint. In *L. hoppinae* the palp may consist of three joints, two, or only one, or the entire structure may be absent.

Gnathopoda.—In the gnathopoda one finds the best characters for the differentiation of species, but the study of immature or dwarfed specimens may be most confusing. The effects of depauperization are most noticeable in modification of the propodi and these structures are most subject to aberrations. In depauperate specimens the processes of the propodi do not develop fully, or in extreme cases not at all, on the other hand, in animals of normal size one or more processes may become over-developed. This is particularly true of the proximal process—when it becomes enlarged it usually produces a reduction in the distal process. These aberrations are apparently of somatic origin as they rarely affect both gnathopoda.

The palmar margin is usually armed with three processes, the proximal, median, and distal, and comparison of the relative development of these has proved most valuable in delimiting species.

Pleopoda.—The first and second pleopoda of the male which have been found so useful in separation of species of *Asellus* are of doubtful value in *Lirceus*. The tip of the endopodite of the second peopoda which in *Asellus* differs so completely from species to species, in *Lirceus* differs only by slight variations in a single basic pattern. The tip is usually bent forward but sometimes it is twisted inwards which gives it a quite different aspect, but the difference is more apparent than real.

Uropoda.—The uropoda vary considerably with age, also they are easily lost and the regenerated ones are never as large as the originals, and in some species dimorphism occurs. However, the uropoda of mature specimens contribute important characters for delimiting species.

Genus LIRCEUS Rafinesque

1820. *Lirceus* Rafinesque, Annals of Nature, 1: 7.

1874. *Asellopsis* Harger, Amer. Jour. Sci. & Arts, III, 7: 601-602. (non) *Asellopsis* Brady & Robertson, Ann. & Mag. Nat. Hist., IV, 12: 137-138. 1873.

1876. *Mancasellus* Harger, Amer. Jour. Sci. & Arts, III, 11: 304-305.

Description.—With the characters of the family Asellidae. Head laterally expanded and flattened and with a well-defined median anterior keel projecting forward between the antennae. Epimera broad, coalesced with their segments. Mandible without a palp, with a three-jointed palp, or of various intermediate conditions. Peni set close together. Suture between the basal and distal segments of the exopodite of the third pleopod very oblique, the distal segment triangular or half-moon shaped.

Type species.—*Lirceus fontinalis* Rafinesque.

Distribution.—Southern Canada and eastern United States west to the Great Plains.

Remarks.—The genus *Lirceus* probably consisted originally of a single entity which under the influence of geographical and ecological isolation has evolved into a number of distinct species which, with a few exceptions, replace each other geographically. This divergence is without pattern or geographical trends. Species inhabiting adjacent areas are apt to differ most.

Unlike *Asellus,* in which the majority of the species are subterranean, *Lirceus* has produced no true cave forms. It is rarely found in caves, and in only one instance is it known to have become modified by cave life.

KEY TO THE SPECIES

1. Mandible with a palp 2
   Mandible without a palp 7
2. Mandibular palp of a stub or one or two joints 3
   Mandibular palp with three joints 5
3. Pleotelson distinctly broader than long ..... *L. hoppinae ozarkensis*
   Pleotelson only very slightly wider than long 4
4. Median propodal process acutely pointed, distinctly longer and more strongly developed than the proximal process; distal process present, small ..... *L. fontinalis*
   Median process blunt, and little, if any longer than the proximal process; distal process absent ..... *L. bidentatus*
5. Both median and distal propodal processes bicuspid ..... *L. bicuspidatus*
   Neither median nor distal propodal processes bicuspid 6
6. Pleotelson wider than long ..... *L. hoppinae hoppinae*
   Pleotelson longer than broad ..... *L. alabamae*
7. Median and distal propodal processes absent ..... *L. brachyurus*
   Median process and usually also the distal process of the propodi present 8
8. Uropodal sinuses of the pleotelson acutely incised ..... *L. trilobus*
   Uropodal sinuses of the pleotelson not acutely incised, represented by rounded concavities or absent 9
9. Endopodite of the uropoda equal to or longer than the basal segment 10
   Endopodite distinctly shorter than the basal segment 15
10. Proximal process of the propodi as large as or larger than the median process 11
    Proximal process distinctly smaller than the median process 12

11. Proximal and median processes of the propodi crowded close together, the distance between them being little if any greater than the width of the proximal process ..... *L. garmani*
Proximal and median processes widely separated, the distance between them being sensibly greater than the width of the proximal process ..... *L. hargeri*
12. Uropoda flattened 13
Uropoda cylindric in form ..... *L. lineatus*
13. Median process of the propodi bicuspid or squarely truncate terminally ..... *L. richardsonae*
Median process either rounded terminally or acutely pointed 14
14. Uropodal sinuses of the pleotelson weakly developed; tip of the median propodal process acutely pointed; pleotelson only slightly broader than long ..... *L. fontinalis*
Uropodal sinuses of the pleotelson moderately well developed, the pleotelson distinctly broader than long; median process of the propodi rounded truncate terminally ..... *L. hoppinae ouachitaensis*
15. Pleotelson longer than broad 16
Pleotelson as broad as long or very distinctly broader 17
16. Proximal process of the propodi large, well developed, larger than the median process ..... *L. megapodus*
Proximal process absent, represented by a blunt spine at the angle of the palm ..... *L. louisianae*
17. Uropoda flattened ..... *L. fontinalis*
Uropoda cylindric ..... *L. lineatus*

As a further aid in the determination of specimens the species are arranged geographically from east to west and from north to south.

LIRCEUS LINEATUS (Say)

1818. *Asellus lineatus* Say, Jour. Acad. Nat. Sci. Phila., 1: 428.
1871. *Asellus tenax* Smith, Amer. Jour. Sci. & Arts, III, 2: 453-454.
1874. *Asellopsis tenax* (Smith). Harger, Amer. Jour. Sci. & Arts, III, 7: 601. Harger, in Smith, Rept. U. S. Comm. Fish & Fisheries for 1872-1873, pp. 659-660, pl. 1, fig. 3.
1874. *Asellopsis tenax* var. *dilata* Harger, in Smith, Rept. U. S. Comm. Fish & Fisheries for 1872-1873, p. 661.
1876. *Mancasellus tenax* (Smith). Harger, Amer. Jour. Sci. & Arts, III, 11: 304-305.
1887. *Mancasellus* sp. n., Herrick, Geol. Surv. Ala. Monog., 2: 40, pl. 5, fig. 8-9. Herrick, Mem. Denison Sci. Assoc., 1: 40, pl. 5, fig. 8.
1900. *Mancasellus lineatus* (Say). Richardson, Amer. Nat., 34: 297.
1902. *Mancasellus danielsi* Richardson, Proc. U. S. Nat. Mus., 25: 505-507.
1905. *Mancasellus tenax dilata* (Smith). Richardson, Bull. U. S. Nat. Mus., no. 54, p. 416.
1936. *Mancasellus dilatus* (Smith). Van Name, Bull. Amer. Mus. Nat. Hist., 71: 479.
1936. *Mancasellus herricki* Van Name, Bull. Amer. Mus. Nat. Hist., 71: 483.

Description.—Size large, broad in proportion to length; length up to 15 mm., width 8 mm. Head laterally incised. Pleotelson greatly expanded proximally, about three-fourths as long as broad; uropodal sinuses small; hind margin slightly concave.

Color pattern continuing onto the pleotelson. Median zone narrow, light, finely mottled; lateral zone light, finely mottled, with very dark borders, giving

the animal the appearance of being four banded; marginal zone broad, light. Occasional lots are a uniform reddish-brown without pattern.

Mandible without a palp.

Propodus of the gnathopod of moderate size. Proximal process consisting of a short, broad, blunt spine which may or may not be fused to the propodus. Median process large, somewhat pointed, and set well away from the proximal process. Distal process a small tubercle set against the base of the dactylus.

Peduncle and rami of the uropoda cylindrical. Size and proportions of the uropoda variable, even in fully developed specimens, usually from two-thirds to one times the length of the pleotelson; inner ramus about two-thirds as long as the peduncle; outer ramus two-thirds to one-third as long as the inner ramus.

Type locality.—Swamps in the forests of South Carolina.

Distribution.—Great Lakes region, and southeastern United States from Virginia to Florida and Alabama.

Localities.—CANADA: ONTARIO: Lake Superior, south side of St. Ignace (S. I. Smith); South Bay, Lake Nipissing; Hallowell (E. B. S. Logier, coll.). UNITED STATES: NEW YORK: JEFFERSON CO.: Alexandria Bay, Thousand Islands (Johansen). MICHIGAN: ALPENA CO.: Thunder Bay, Lake Huron (Smith); WAYNE CO.: Detroit River, Ecorse (Smith). LUCE CO.: Taquamenon River, north of Newberry. SCHOOLCRAFT CO.: Gulliver Lake. MENOMINEE CO.: Lake Ann; Long Lake; Bass Lake; Baker Lake. BENZIE CO.: Big Platte Lake. CHEBOYGAN CO.: Black Lake. PRESQUE ISLE CO.: Black Lake. VAN BUREN CO.: North Lake. ILLINOIS: LAKE CO.: Fox Lake (Shelford). INDIANA: LAKE CO.: creek 2 miles north of Hobart. LAPORTE CO.: Lily Lake, Laporte (Richardson); NOBLE CO.: outlet of drain, 1.4 miles west of Wawaka. VIRGINIA: SUSSEX CO.: Blackwater River, 4 miles north of Wakefield. NANSEMOND CO.: small stream in swamp, 4 miles west of Suffolk. SOUTH CAROLINA: BERKELEY CO.: slough, 3 miles northwest of Cordesville. GEORGIA: JENKINS CO.: 2 miles south of Millen (Horton H. Hobbs, coll.). FLORIDA: COLUMBIA CO.: Lake City (Hobbs, coll.). ALACHUA CO.: Blues Creek; Gainesville; Wauberg Lake (Hobbs, coll.); swamp, 4.5 miles east of Gainesville. WASHINGTON CO.: creek (Hobbs, coll.). TENNESSEE: MONROE CO.: spring, Sweetwater. ALABAMA: MADISON CO.: Big Spring, Huntsville; slough, 2.7 miles northwest of Gurley. JACKSON CO.: slough, 1.6 miles northwest of Paint Rock. LAWRENCE CO.: springs, 5 miles east of Wheeler; spring fed slough, 1.7 miles east of Courtland.

Remarks.—There are two geographically isolated populations of this species, judging by the available records. No character could be found that would separate the two populations, although such was especially looked for. Depauperization is much greater both in degree and frequency in the southeastern population.

Plate 1, figs. C and G, show the pleotelson and uropod of a specimen from Wheeler, Ala., in which depauperization involves both body proportions and size and also the development of the appendages. Figs. D and H, show the pleotelson and uropoda of a specimen from Gainesville, Fla., in which the body is greatly reduced in size and proportions but the appendages are normal. Fig. E shows the pleotelson of a specimen from Huntsville, Ala., in which the depauperization has affected size only. Fig. B, shows a depauperate palm of a gnathopod from Gurley, Ala. Figs. A, F, and I, show well-developed parts of a specimen from Hobart, Ind.

LIRCEUS BRACHYURUS (Harger)

1876. *Mancasellus brachyurus* Harger, Amer. Jour. Sci. & Arts, III, 11: 304-305.

Description.—Of moderate size, rather broad in proportion to length; length up to 14 mm., width 6 mm. Head not laterally incised. Pleotelson moderately expanded proximally, its length about eighty percent of its breadth; uropodal sinuses moderately developed; hind margin convex.

Color pale gray, pattern weak when present. Median zone unmottled; lateral zone lighter than either the median or marginal zones, without dark borders; marginal zone moderately broad, rather dark. Pleotelson often with a light spot at the base.

Mandible without a palp.

Gnathopoda small and undeveloped, strongly resembling very immature ones of other species; proximal process consisting of a short, blunt spine; median and distal processes absent; palmar margin concave; dactylus without a process but often armed with a series of short, heavy spines along the inner margin.

Uropoda very small, about one-third as long as the pleotelson; peduncle almost as broad as long, inner ramus about one and one-half times as long as the peduncle, outer ramus about two-thirds as long as the inner ramus.

Type locality.—Rockbridge Co., Virginia.

Distribution.—Springs and small streams, Atlantic drainage from northeastern Pennsylvania to northern Virginia.

Localities.—PENNSYLVANIA: WAYNE CO.: ponds of the fish hatchery, Pleasant Mount (Van Name). CHESTER CO.: under stones, Valley Creek, Valley Forge. VIRGINIA: FREDERICK CO.: Hopewell Spring, Winchester; Marlboro Spring, Marlboro (H. W. Jackson, coll.). CLARKE CO.: Gaylord (Richardson). SHENANDOAH CO.: Lantz Mill Spring, Fadley's cress beds, Lantz; Hinkins Spring, Strasburg; spring, near headwaters, Passage (Perry) Creek, Shenandoah National Park (Jackson, coll.). ROCKINGHAM CO.: Moyer's cress beds, Mt. Crawford; County Poor House Spring, Harrisonburg; Lacey Springs (Jackson, coll.). ROCKBRIDGE CO.: McKee's Spring, Lexington (Richardson). AUGUSTA CO.: Barterbrook springs, 2 miles north of Stuarts Draft (Greta van Schaik, coll.).

Remarks.—Dr. H. W. Jackson hunted extensively in Rockbridge Co., Virginia, for this species but did not find it.

Lirceus hargeri sp. nov.

Description.—Size rather small, length up to 12 mm. width 4.5 mm. Head laterally incised. Pleotelson slightly expanded proximally, a little shorter than broad, uropodal sinuses moderately developed, hind margin rounded.

Color moderately dark gray; median zone somewhat mottled; lateral zone distinctly mottled without darker borders; marginal zone medium gray. Pleotelson without color pattern.

Mandible without a palp.

Propodus of the gnathopod of moderate size. Proximal process large, pointed. Median process almost as large as the proximal process, crowded against the distal process, tip rounded. Distal process small, set against the base of the dactylus.

Uropoda moderately setose, about two-thirds as long as the pleotelson; peduncle rather slender, a little shorter than the inner ramus; outer ramus almost as long as the inner.

Type locality.—A spring, 2 miles south of Rogersville, Hawkins Co., Tennessee.

Distribution.—Northeastern Tennessee and adjacent Virginia.

Localities.—TENNESSEE: HAWKINS CO.: spring, 2 miles south of Rogersville. CLAIBORNE CO.: Davis' Spring, 2.6 miles south of Harrogate; small spring, 1.7 miles southeast of Tazewell. VIRGINIA: LEE CO.: spring, Blackwell.

Lirceus alabamae sp. nov.

Description.—Size rather small, narrow in proportion to width; length up to 12 mm., width 3.5 mm. Head laterally incised. Pleotelson not expanded proximally, as long as broad, uropodal sinuses weakly developed, hind margin rounded.

Color rather pale gray, pattern not continuing onto the pleotelson; median zone not mottled; lateral zone distinctly mottled, without darker borders; marginal zone rather narrow, not lighter than the median zone.

Mandible with a three-jointed palp.

Propodus of the gnathopoda of medium size. Proximal process rather small, pointed; median process well developed, slender, tip rounded; distal process well developed, tip rounded, set away from the base of the dactylus.

Uropoda almost as long as the pleotelson, setae rather weakly developed; inner ramus somewhat longer than the peduncle; outer ramus about three-fourths as long as the inner.

Type locality.—Large seeps, 5.3 miles southeast of Mentone, DeKalb Co., Alabama.

Distribution.—Northern Alabama.

Localities.—ALABAMA: ST. CLAIR CO.: Aughtrys Spring, 3 miles northwest of Whitney. DEKALB CO.: large seeps, 5.3 miles southeast of Mentone. LAWRENCE CO.: springs, 5 miles east of Wheeler. FRANKLIN CO.: seep, on road to Evens Cave, 2 miles northeast of Spruce Pine. TUSCALOOSA CO.: seep, 2.6 miles south of Samantha School; seep, 2.2 miles west of Bucksville; small spring, 3.2 miles west of Bucksville.

Lirceus richardsonae sp. nov.

Description.—Size large, length up to 18 mm., width 8 mm. Head laterally incised. Pleotelson slightly expanded proximally, about four-fifths as long as broad, uropodal sinuses weakly developed, hind margin rounded.

Color pattern not continuing onto the pleotelson; median zone dark brownish gray, unmottled; lateral zone distinctly mottled, usually narrowly bordered with dark: marginal zone moderately broad, medium gray.

Mandible without a palp.

Propodus of the gnathopod rather large; proximal process average size or a little larger, pointed; median process well developed, broad, bicusped; distal process small, set against the base of the dactylus.

Peduncle and rami of the uropoda rather broad and much flattened, about two-thirds as long as the pleotelson; inner ramus as long as the peduncle; outer ramus a little more than two-thirds as long as the inner.

Type locality.—Outlet of drain, 1.3 miles southeast of Perryville, Wood Co., Ohio.
Distribution.—Known only from the type collection.

LIRCEUS FONTINALIS Rafinesque

1820. *Lirceus fontinalis* Rafinesque, Annals of Nature, 1: 7.
1890. *Mancasellus macrourus* Garman, Bull. Essex Inst., 22: 28-30.

Description.—Size large, length up to 17 mm., width 6.5 mm. Head laterally incised. Pleotelson not expanded proximally, a little shorter than broad; uropodal sinuses weakly developed, hind margin slightly convex.

Color dark brown; dark borders of the lateral zone continuing onto the pleotelson; median zone light; lateral zone strongly mottled, with dark borders; marginal zone moderately broad, light gray.

Mandible without a palp or with a stump, rarely with a full joint.

Gnathopoda variable, consisting of two intergrading types. First type: Proximal process small, tip rounded; median process well developed, tip pointed; distal process weakly developed, set close against the base of the dactylus. Second type: similar to the first but the proximal and distal processes moderately developed, median process not quite as broad.

There are two rather distinct types of uropoda. First type: somewhat flattened, about two-thirds as long as the pleotelson, setae weakly developed; inner ramus somewhat shorter than the peduncle; outer ramus about three-fourths as long as the inner. Second type: a little more than one-half as long as the pleotelson, flattened, setae moderately developed; inner ramus a little longer than the peduncle, outer ramus about seven-eighths as long as the inner.

Type locality.—Springs and small streams near Lexington, Kentucky.

Distribution.—Southwestern Ohio, southern Indiana and Illinois, south to the Nashville Basin, Tennessee.

Localities.—OHIO: BROWN Co.: spring, 5 miles south of Georgetown. CLINTON Co.: spring branch, 2.2 miles north of Wilmington; small spring, 0.7 mile southeast of Westboro. PREBLE Co.: outlet of drain, 0.2 mile northwest of New Hope; small stream, 3.3 miles southeast of New Hope. GREENE Co.: spring, John Bryan State Park; springs 0.7 mile west of Clifton. HAMILTON Co.: near Cincinnati. BUTLER Co.: 1 mile south of West Chester (R. & K. E. Goellner, coll.). INDIANA: JEFFERSON Co.: Hanover. LAWRENCE Co.: stream in Shiloh Cave, 2 miles east of Fayetteville; Twin Caves Sink, Spring Mill State Park. HENDRICKS Co.: spring, 2 miles east-northeast of Plainfield. ORANGE Co.: spring, 8.6 miles south of Paoli. MARTIN Co.: Ellis Spring, 3.5 miles east of Loogootee. CRAWFORD Co.: Sharp's Spring, Wyandotte. MONROE Co.: spring, 5 miles southwest of Bloomington. HENRY Co.: outlet of drain, 1.4 miles west of Straughn; small stream, 1.3 miles northwest of Blountsville. ILLINOIS: CHAMPAIGN Co.: near Urbana. CLARK Co.: spring, 1.9 miles east-northeast of Marshall. KENTUCKY: GRAYSON Co.: spring, 1.3 miles northeast of Clarkson. CHRISTIAN Co.: spring, Pollard farm, 5 miles northwest of Hopkinsville. NELSON Co.: small spring, 4 west of Bardstown. GARRARD Co.: springs, 2 miles northwest of Lancaster. FAYETTE Co.: spring, 1 mile east of Warrenton; spring, 0.8 mile east of Fort Spring. JESSAMINE Co.: springs, 2.7 and 6.1 miles north of Nicholasville. BOURBON Co.: small spring, 2.8 miles southwest of Millersburg; spring, 5.7 miles southwest of Paris. LINCOLN Co.: small spring, 1 mile south of Preachersville. MASON Co.: spring, 1:6 miles north of Washington. WOODFORD Co.: Sunnyside Farm spring, 4.5 miles east of Versailles. JEFFERSON Co.: Echo Farm spring, 3.8 miles west of Simpsonville. TENNESSEE:

WILSON CO.: spring, 2.2 miles north of Bairds Mill. DAVIDSON CO.: spring, "Fortland," near Shelby Park, Nashville. WILLIAMSON CO.: small spring, 1.2 miles northeast of Franklin. MAURY CO.: seeps along Duck River, 6 miles southeast of Columbia; springs, 2.3 miles southwest of Spring Hill. BEDFORD CO.: spring, 2.5 miles west of Shelbyville. CHEATUM CO.: spring, near Good Spring Church, 2.6 miles southeast of Pleasant View. TROUSDALE CO.: spring, 2.6 miles east of Castalian Springs. DE KALB CO.: stream in Ted Cave, 5 miles east of Smithville.

LIRCEUS LOUISIANAE (Mackin & Hubricht)

1938. *Mancasellus louisianae* Mackin & Hubricht, Amer. Midl. Nat., 19: 634.

Description.—Size rather small, narrow in proportion to length; length up to 13 mm., width 4.5 mm. Head laterally incised. Pleotelson not expanded proximally, as long as broad; uropodal sinuses moderately developed; hind margin rounded.

Color grayish-brown; pattern not continuing onto the pleotelson. Median zone unmottled; lateral zone conspicuously mottled, without dark borders; marginal zone narrow, very light.

Mandible without a palp.

Propodus of the gnathopod of moderate size. Proximal process consisting of a short, blunt spine; median process well developed, truncate; distal process moderately developed, set against the base of the dactylus.

Uropoda flattened, about one-half as long as the pleotelson, setae well developed; inner ramus a little longer than the peduncle; outer ramus two-thirds as long as the inner.

Type locality.—Among dead leaves in a small creek below an artificial pond, property of Miss Caroline Dorman, 2 miles south of Saline, Natchitoches Parish, Louisiana.

Distribution.—Mississippi Embayment from southern Illinois and southeastern Missouri to northern Louisiana.

Localities.—ILLINOIS:: UNION CO.: small spring-fed marsh, 2.5 miles east of Ware; temporary pool, near McCann School, 2.5 miles northeast of Aldridge. MISSOURI: BUTLER CO.: temporary pool, roadside ditch, 2.7 miles west of Ash Hill; slough, 6.1 miles north of Neelyville. ARKANSAS: JEFFERSON CO.: slough, 4.3 miles northeast of Altheimer. LAWRENCE CO.: roadside slough, 2 miles southwest of Minturn; roadside ditch, 0.6 miles west of Hoxie. ARKANSAS CO.: slough, 2.7 miles east-northeast of Humphreys. CRAIGSHEAD CO.: small stream, 2.6 miles south of Aptspur. MONROE CO.: slough, 1.1 miles north of Holly Grove. PHILLIPS CO.: slough, 0.5 mile southeast of Turner. LOUISIANA: RICHLAND CO.: slough, 1 mile northwest of Crew Lake. CLAIBORNE CO.: seeps, 0.6 miles south of Junction City. NATCHITOCHES CO.: small creek, 2 miles south of Saline.

Remarks.—The original description of this species was based upon depauperate specimens which accounts for the difference between it and the above description which is based upon fully developed material from Hoxie, Arkansas.

Lirceus megapodus sp. nov.

Description.—Size large, narrow in proportion to length; length up to 17 mm., width 5 mm. Head laterally incised. Pleotelson not expanded proximally, a little longer than broad; uropodal sinuses very small or absent; hind margin convex.

Color rather dark grayish-brown, shining; pattern not continuing onto the pleotelson. Median zone unmottled, dark; lateral zone weakly mottled, without dark borders; marginal zone moderately broad, translucent gray.

Mandible without a palp.

Propodus of the gnathopod very large, larger than in any other known species. Proximal process well developed, pointed; median process well developed; tip rounded; distal process moderately well developed, bluntly pointed, set away from the base of the dactylus.

Uropoda very flat, setae inconspicuous, about four-fifths as long as the pleotelson; inner ramus and peduncle of equal length; outer ramus about four-fifths as long as the inner.

Type locality.—Spring, 4 miles northwest of Hogan, Iron Co., Missouri.

Distribution.—St. Francis Mountains of southeastern Missouri.

Localities.—MISSOURI: ST. FRANCOIS CO.: small spring, 1.5 miles northeast of Doe Run. IRON CO.: small spring, 2 miles north of Belleview; spring, 4 miles northwest of Hogan.

LIRCEUS HOPPINAE HOPPINAE (Faxon)

1889. *Asellus hoppinae* Faxon, in Garman, Bull. Mus. Comp. Zool. 17: 237.
1936. *Asellus incisus* Van Name, Bull. Amer. Mus. Nat. Hist., 71: 464-465.
1940. *Mancasellus incisus* (Van Name). Mackin, Proc. Okla. Acad. Sci., 20: 17.

Description.—Size rather large, length up to 16 mm., width 6.5 mm. Head may or may not be laterally incised. Pleotelson not expanded proximally, about four-fifths as long as broad; uropodal sinuses moderately developed; hind margin rounded.

Color rather dark gray; pleotelson sometimes slightly mottled. Median zone dark, unmottled; lateral zone distinctly mottled, without dark borders; marginal zone broad, as dark as the median zone.

Mandible with a three-jointed palp.

Propodus of the gnathopod of medium size. Proximal process moderately developed, tip blunt; median process well developed, truncate; distal process consisting of a small tubercle against the base of the dactylus.

Uropoda about four-fifths as long as the pleotelson, not greatly flattened, setae weakly developed; inner ramus a little longer than the peduncle; outer ramus about four-fifths as long as the inner.

Type locality.—Stream in Day's (Dowler's) Cave, Sarcoxie, Jasper Co., Missouri.

Distribution.—Southwestern Ozark region.

Localities.—MISSOURI: JASPER CO.: Dowler (Day) Cave spring, Sarcoxie. NEWTON CO.: spring, 1.4 miles north of Tipton Ford; Big Spring, Neosho; spring, 3.6 miles west of Neosho; spring, 2.7 miles northwest of Neosho. CHRISTIAN CO.: mouth of Smallin Cave, 2.8 miles northeast of Ozark. STONE CO.: Pine Creek Cave, Galena (Kenneth Dearolf, coll.). BARRY CO.: Roaring River Spring. ARKANSAS: WASHINGTON CO.: spring, 2.2 miles north of Dutch Mills. BENTON CO.: Big Spring, Bella Vista. MARION CO.: spring, 16.3 miles south-southeast of Yellville. IZARD CO.: small spring on bluff, Calico Rock.

Lirceus hoppinae ozarkensis subsp. nov.

Description.—Differing from *Lirceus hoppinae hoppinae* in that the mandibular palp is composed of only one segment, rarely two.

Type locality.—Stream at mouth of Maxey Cave, 2 miles north of Hanna, Pulaski Co., Missouri.

Distribution.—Central Ozark region, Missouri and northern Arkansas.

Localities.—MISSOURI: PULASKI CO.: Hancock Spring, 2 miles east of Crocker; Riden Cave Spring, 2 miles west of Duke; Miller Spring, 3 miles northeast of Big Piney; stream at mouth of Maxey Cave, 2 miles north of Hanna; stream in Bruce Cave, 2.5 miles west of Jerome; stream in Kraft Cave, 2 miles north of Waynesville. MARIES CO.: stream in Boulware Cave, 12 miles south of Vienna. LACLEDE CO.: spring, mouth of Davis Cave, 1.4 miles south of Pease. TEXAS CO.: spring, mouth of Bat Cave, 7 miles northeast of Success. OREGON CO.: spring, 4.4 miles west of Thayer. ARKANSAS: BOONE CO.: Bear Creek Springs, Francis.

LIRCEUS HOPPINAE OUACHITAENSIS (Mackin & Hubricht)

1938. *Mancasellus ouachitaensis* Mackin & Hubricht, Amer. Midl. Nat., 19: 632-633.

Description.—Differing from *Lirceus hoppinae hoppinae* in that the mandible is without a palp.

Type locality.—Tributary of Kiamichi River, near Big Cedar, Leflore Co., Oklahoma.

Distribution.—Western Ouachita Mountains, eastern Oklahoma.

Localities.—OKLAHOMA: LEFLORE CO.: tributary of Kiamichi River, near Big Cedar. LATIMER CO.: tributaries of the Fourche Maline River, State Game Preserve, north of Wilburton. PUSHMATAHA CO.: tributaries of the Kiamichi River, near Tuskanoma.

Lirceus bidentatus sp. nov.

Description.—Medium sized, narrow in proportion to length; length up to 14 mm., width 4.5 mm. The head may or may not be laterally incised. Pleotelson not expanded proximally, almost as long as broad; uropodal sinuses moderately developed; hind margin rounded.

Color light gray, pattern not continuing onto the pleotelson. Median zone rather dark, unmottled; lateral zone, distinctly mottled, without darker borders; marginal zone rather wide, very light gray.

Mandible with a one-jointed palp.

Propodus of the gnathopod rather large; proximal process well developed, pointed; median process well developed, very broad, bluntly pointed; distal process absent.

Uropoda flattened; setae moderately developed; a little less than two-thirds as long as the pleotelson; inner ramus a little longer than the peduncle; outer ramus about three-fourths as long as the inner.

Type locality.—Seep, Boston Mountains, 9 miles southwest of Harrison, Boone, Co., Arkansas.

Distribution.—Known only from the type collection.

Remarks.—This is the only species which can be distinguished by the second pleopoda of the male. In all species there is a depression in the tip of

the endopodite in the center of which is a slender process. In most species this process barely projects above the rim of the depression. In *L. bidentatus* this process is greatly enlarged, equalling in length the diameter of the endopodite.

Lirceus bicuspidatus sp. nov.

Description.—Size large; length up to 18 mm., width 6.5 mm. Head not laterally incised. Pleotelson not expanded proximally, about nine-tenths as long as broad; uropodal sinuses weakly to moderately developed; hind margin rounded.

Color dark brownish-gray; pleotelson with a slight pattern; median zone unmottled; lateral zone very distinctly mottled, with dark borders; marginal zone rather narrow, dark.

Mandible with a three-jointed palp.

Propodus of the gnathopod somewhat large; proximal process moderately developed, broad, tip rounded; median process well developed, broad, bicuspid; distal process well developed, bicusped, set away from the base of the dactylus.

Uropoda flattened, setae not conspicuous, about seven-eighths as long as the pleotelson; inner ramus a little longer than the peduncle; outer ramus about two-thirds as long as the inner.

Type locality.—Spring on a small stream flowing behind the College Chapel, Clarksville, Johnson Co., Arkansas.

Distribution.—Boston and Ouachita Mountains of Arkansas.

Localities.—ARKANSAS: JACKSON CO.: small stream on hillside, 1.5 miles southeast of Olyphant. NEWTON CO.: small seeps, 4 miles south of Boxley; small stream, 9.6 miles south of Boxley; spring below Diamond Cave, 4.6 miles southwest of Jasper; spring, Yardelle. SEARCY CO.: spring, mouth of Hurricane Cave, 4 miles southwest of Pindall; small spring, 1.6 miles northwest of St. Joe. YELL CO.: stream, 2.6 miles southeast of Ola. POPE CO.: temporary stream, 2 miles southeast of London. CONWAY CO.: small stream, Petit Jean State Park. JOHNSON CO.: creek, Kings Canyon, 5 miles north of Clarksville; spring, near Lee's Tavern, 2 miles northeast of Clarksville; spring on small creek, west of the College Chapel, Clarksville. LOGAN CO.: stream, side of Magazine Mtn., 2.6 miles southeast of Corley; spring, on Shelf Road of Mt. Nebo, Mt. Nebo State Park. SALINE CO.: seep, 5 miles north of Peron. PULASKI CO.: small stream, 3 miles northeast of North Little Rock.

Lirceus garmani sp. nov.

Description.—Size rather small, narrow in proportion to length; length up to 13 mm., width 4.5 mm. Head usually not laterally incised. Pleotelson slightly expanded proximally, about nine-tenths as long as broad; uropodal sinuses moderately developed, hind margin rounded.

Color grayish-brown, pleotelson without pattern. Median zone narrow, unmottled, dark; lateral zone distinctly mottled, without darker borders; marginal zone rather broad, light.

Mandible without a palp.

Propodus of the gnathopod rather small, thick; proximal process well

developed, pointed, projecting slightly forward, set close to the median process; median process moderately developed, tip rounded; distal process moderately developed, set against the base of the dactylus.

Uropoda flattened, about two-thirds as long as the pleotelson; rami tapering distally, setae well developed; inner ramus about as long as the peduncle; outer ramus about three-fourths as long as the inner.

Type locality.—Temporary stream, 3.6 miles east of Cedar Springs, Cedar Co., Missouri.

Distribution.—Eastern Kansas and Oklahoma, western Missouri and northwestern Arkansas.

Localities.—MISSOURI: LACLEDE CO.: small stream, near Bennett Spring. ST. CLAIR CO.: spring, Collins. CEDAR CO.: temporary stream, 3.6 miles east of Cedar Springs. VERNON CO.: temporary stream, 12.7 miles east of Nevada. ARKANSAS: SCOTT CO.: creek, Y-City, 4 miles south of Boles. FAULKNER CO.: temporary stream, 0.6 miles south of Wooster. KANSAS: FRANKLIN CO.: abandoned well, Wheeler farm, 5 miles south-southeast of Ottawa; spring, Dunkak farm, 1.5 miles northwest of Lane. BOURBON CO.: seep, 2.3 miles south of Bronson; seep, 2.2 miles east of Uniontown. JOHNSON CO.: small temporary stream, 1 mile east-northeast of Clare. DOUGLASS CO.: temporary ponds, 2.5 miles south of Lawrence (Luke H. Ponder, coll.). OKLAHOMA: MAYES CO.: spring, Girl Scout Camp, 3.2 miles south of Locust Grove; spring, at roadside park, 1 mile east of Locust Grove; spring, 3.7 miles west of Locust Grove. WAGONER CO.: small temporary stream, 11 miles west of Inola. OKFUSKEE CO.: Seeping Springs, near Scout camp at Okemah. SEMINOLE CO.: pond near Cromwell. PONTOTOC CO.: City Lake (artifiical, 25 years old), Ada; also in various small temporary tributaries of every creek in the county. JOHNSTON CO.: small creek, branch of Pennington River, Devil's Den Park, 4 miles north of Tishomingo; pond, 5 miles south of Connerville. WOODS CO.: small creek, near airport, Waynoka.

Lirceus trilobus sp. nov.

Description.—Size rather small; length up to 12 mm., width 4 mm. Head laterally incised. Pleotelson slightly expanded proximally, about nine-tenths as long as broad; uropodal sinuses strongly developed; hind margin rounded.

Color light grayish-brown, pattern not continuing onto the pleotelson; median zone unmottled; lateral zone distinctly mottled, without darker borders; marginal zone of moderate width, about as dark as the median zone.

Mandible without a palp.

Propodus of the gnathopod of moderate size. Proximal process moderately developed, projecting somewhat backwards, tip rather blunt; median process well developed, broad, tip rounded or slightly truncate; distal process small, set against the base of the dactylus.

Uropoda flattened, as long as the pleotelson; inner ramus slightly longer than the peduncle; outer ramus a little more than one-half as long as the inner. Setae very small, inconspicuous.

Type locality.—Woodland pools, Girl Scout Camp, 3.2 miles south of Locust Grove, Mayes Co., Oklahoma.

Distribution.—Known only from the type collection.

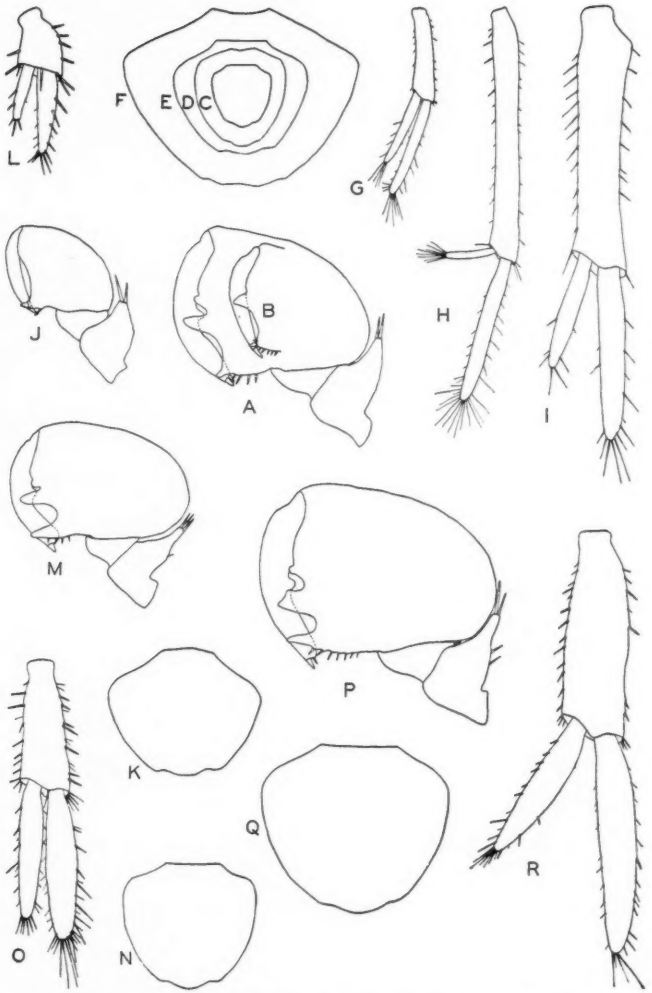


PLATE 1. A-I, *L. lineatus*.—A, gnathopod, Hobart, Indiana. B, gnathopod, Gurley, Alabama. C, pleotelson, Wheeler, Alabama. D, pleotelson, Gainesville, Florida. E. pleotelson, Huntsville, Alabama. F, pleotelson, Hobart, Indiana. G, uropod, Wheeler, Alabama. H, uropod, Gainesville, Florida. I, uropod, Hobart, Indiana. J-L, *L. brachyrus*. J, gnathopod. K, pleotelson. L, uropod. M-O, *L. Hargeri*. M, gnathopod. N, pleotelson. O, uropod. P-R, *L. richardsonae*. P, gnathopod. Q, pleotelson. R, uropod.

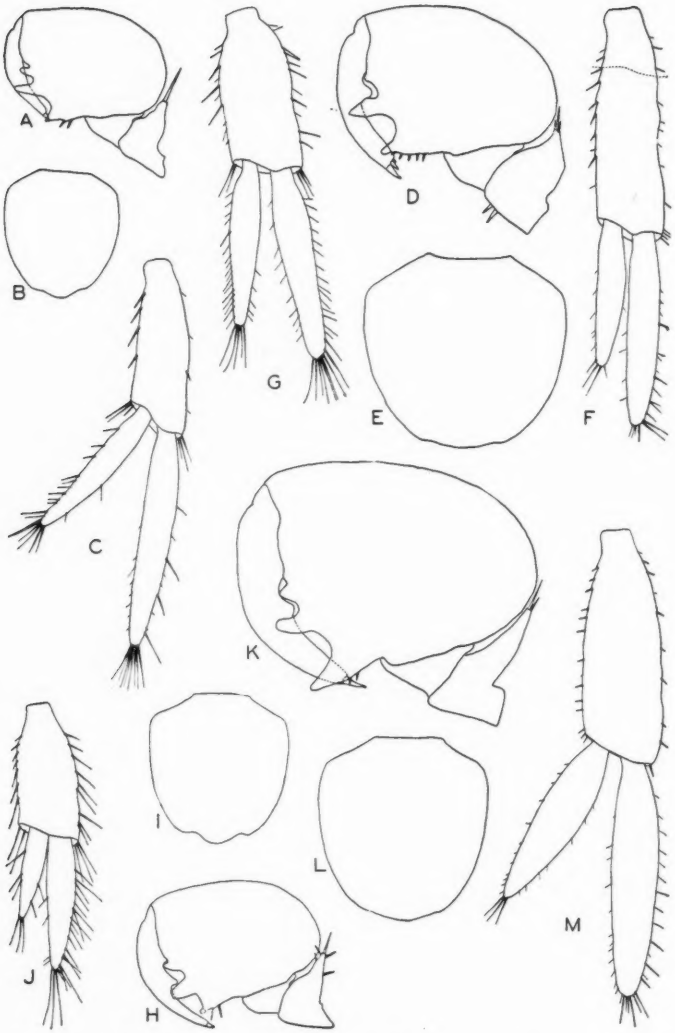


PLATE 2. A-C, *L. alabamae*.—A, gnathopod. B, pleotelson. C, uropod. D-G, *L. fontinalis*. D, gnathopod. E, pleotelson. F, uropod, Lexington, Kentucky. G, uropod, Castalian Springs, Tennessee. H-J, *L. louisianae*. H, gnathopod. I, pleotelson. J, uropod. K-M, *L. megapodus*. K, gnathopod. L, pleotelson. M, uropod.

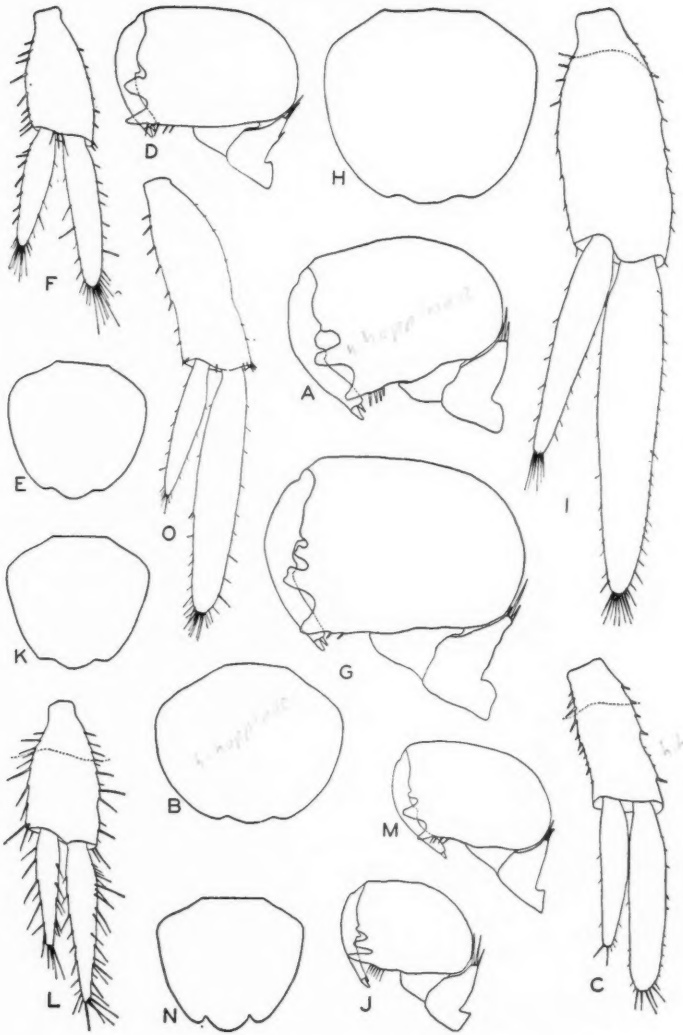


PLATE 3. A-C, *L. h. hoppinae*.—A, gnathopod. B. pleotelson. C, uropod. D-F, *L. bidentatus*. D, gnathopod. E, pleotelson. F. uropod. G-I, *L. bicuspidatus*. G, gnathopod. H, pleotelson. I, uropod. J-L, *L. garmani*. J, gnathopod. K, pleotelson. L, uropod. M-O, *L. trilobus*. M, gnathopod. N, pleotelson. O, uropod.

The Genus Brevipalpus (Acarina: Pseudoleptidae)

Edward W. Baker

Bureau of Entomology and Plant Quarantine,
Agricultural Research Administration, U. S. D. A., Washington, D. C.

Within the last few years several species of *Brevipalpus* have been found to be pests of cultivated plants. Although not so important as the *Tetranychidae* or spider mites, they are at times serious enough to warrant investigations of their biology and control. This paper is a review of the taxonomy of the genus. Although some of the early described species cannot yet be identified, reproductions of many of the figures and references to the early literature are given. Owing to the minute differences between some of the species, such as *donnadieui* and its close relatives, final determinations can be made only when material from type hosts and localities can be studied. For this reason certain early names, such as *obovatus,* cannot now be applied to any species in available collections, and some recently described species may prove to be synonyms of these earlier described mites.

The following review indicates the type and severity of the injury caused by these mites. Green (1900) records a species of *Brevipalpus* as causing serious damage to tea plants in Ceylon. Originally determined as *B. obovatus* Donnadieu, or very close to it, specimens received from C. H. Gadd, Ceylon, have proved to be *B. australis* (Tucker). Green states, "Apparently a very injurious pest. The branches—and whole bushes—are almost denuded of leaves, the bark shriveled and hide-bound. The terminal buds have ceased growing. In some instances the trees have been actually killed. The mites are crowded on the under surface of the leaves, and their attack results in a brownish scurfy discoloration extending along the midrib and on each side of it, the base of the leaf being particularly affected, causing its premature detachment." Bernard (1909) also discusses this species in some detail. Although still considered as a pest of tea (King 1936), it is the least numerous of the species of mites attacking that plant.

McGregor (1916) reports defoliation of privet by *Brevipalpus inornatus* (Banks) throughout Florida, South Carolina, Alabama, Mississippi and Louisiana. Blanchard (1940) states that *Brevipalpus pseudocuneatus* (Blanchard) is a carrier of a virus disease of citrus in Argentina. Jones, et al. (1941) report species of *Brevipalpus* (probably *papayensis* n. sp.) as sometimes causing serious damage to papaya fruits in Hawaii. The fruits develop gray, scaly or cracked areas, most frequently at points where they are in contact with the trunk.

Lewis (1944) found a *Brevipalpus* (described later as *B. lewisi* McGregor) scarring lemon fruit at Porterville, California. In parts of an infested grove which had received no commercial spray treatment for about ten years, more

than twenty-five percent of the fruit was scarred, but in adjacent orchards which had been treated regularly these mites were hard to find. Lewis also states that "Injury is apparent to tender wood and fruit stems as a darkened, scarred area confined to the upper surface. Buttons are also darkened. Leaf injury, though present is of no importance."

In Valencia, Spain, Planes (1945) found an undetermined species[1] causing scarring of citrus fruits. In cases of large numbers of mites the leaves and pedicles are scarred and defoliation can occur.

Sloan (1946) gives the following description of *Brevipalpus*[2] damage to passion vines in Queensland.

"The passion fruit mite is a common, but frequently unrecognized, cause of the unthrifty appearance and premature death of passion fruit vines.

"Passion vines may be attacked at any age and even young plants show severe injury if growing conditions are unfavourable. The older leaves of the vine turn yellow prematurely. These then die and are shed. The injured surface of the canes becomes covered with a rusty-red corky layer showing small cracks. This injury persists even after the mites have been checked and gives an indication of the extent of previous infestations. Heavy attacks over a long period may cause the shedding of the greater part of the foliage, leaving many canes bare except for the terminals. Buds in the axils of affected leaves may fail to develop or produce only yellowish stunted growth. Not infrequently, the less sturdy laterals die back to the main cane. A moderate attack will bring about a serious loss of vigour, while severe attacks over a prolonged unfavourable growing period may lead to the death of the entire vine. The general picture of a mite-affected vine is that of one suffering from lack of soil moisture.

"Injury to the fruit occurs only in heavy infestation and is at first restricted to the stalk end, particularly under and around the calyx. Later, mites may be more freely distributed over the surface and water-soaked areas then disfigure the rind. These later dry out, leaving dull-grayish areas which are sometimes tinged with reddish-brown. The affected fruit may fail to develop fully.

"Usually, the mite causes little apparent damage in spring, so long as the vines are making good progress, but injury may become pronounced later in the warmer months, especially if growing conditions are such as to retard growth and if the vines are fruiting heavily. Vines that are heavily infested in the summer and early autumn make a partial recovery during winter and subsequently the growth may proceed normally until mite populations again become high during the following summer."

Mites of this genus appear to be distributed throughout the temperate regions of the world. Lawrence (1943) discussing *Tenuipalpus* s. l. which now includes *Tenuipalpus* and *Brevipalpus*, states, "It seems that indigenous species of *Tenuipalpus* are always found on indigenous host plants and will

1 Specimens sent by Mr. Planes have been determined as *Brevipalpus pseudocuneatus* (Blanchard).

2 Reported as *Tenuipalpus californicus* Banks; possibly a misidentification.

usually be confined to a single one, while introduced species will occur on a large and mixed assembly of native and foreign plants."

The finer techniques of mounting and studying these small mites have enabled workers to begin properly to separate the species. The discovery that in the nymphal stages the setal patterns are usually strikingly distinct has made the separation and identification of species much easier. Occasionally colonies of more than one species occur, in which case care must be exercised in properly associating the nymphs with adults. This can be done by the hysterosomal setae count or by the finding of molting specimens containing adult forms. Nymphs described in this paper have been found associated with adults, and in no cases have any forms been reared. However, I feel confident that the nymphal forms have been correctly identified. Not enough larvae have been studied to evaluate their characters. Some larvae possess long posterior whip-like setae similar to those of *Tenuipalpus;* these are lost in the nymphal stage. Males likewise show specific differences.

The extent of variation within a species is not yet known, but there is an indication, in *B. inornatus* (Banks) for example, that in the nymphal stages certain of the setae, usually the small marginal ones, may occasionally vary in size. It must be borne in mind that the key to the nymphs is based upon a few individuals of each species, and further studies may find variations which are not yet known. In the adult females it was found that the rostral shield was too variable to be of much importance in specific identification.

Unless otherwise stated types are deposited in the United States National Museum.

The genus *Brevipalpus* Donnadieu 1875, family Pseudoleptidae,[3] is distinguished by its small size, its four-segmented palpus in which the second segment bears a single seta, the third a pair of setae, and the fourth three setae; its flat egg-shaped body; its reticulate skin pattern; the usually wrinkled legs with a pair of claws, pulvillus and tenent hairs; the presence of distinct hysterosomal genital plates; the shieldlike process extending out over the rostrum; a pair of simple setae on the venter of the rostrum; two pairs of lateral lenslike eyes; a distinct dorsal suture between the propodosoma and hysterosoma in the female; a distinct dorsal suture between the propodosoma and hysterosoma and another dividing the hysterosoma into two parts in the male; and in having long needle like chelicerae capable of extrusion.

The type of the genus is *Brevipalpus obovatus* Donnadieu 1875. (By designation, Vitzthum, 1942.)

Baker, 1945, recognized the validity of the genus *Brevipalpus* and separated it from *Tenuipalpus* under which it had been synonymized. He stated, "and the name *Brevipalpus* Donn., 1875, which has been synonymized with *Tenuipalpus*, should be reinstated as the generic name for the *inornatus* group of mites." It is considered that the proper name combinations were implied in this sentence so new combinations are listed in this paper.

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3 Oudemans, 1938, placed *Pseudoleptus* in synonymy with *Trichadenus* but the study of the group shows the two genera to be distinct and the name Pseudoleptidae should be used rather than Trichadenidae.

Keys to the species in the United States National Museum are given below. Wherever possible species not examined have been included, based on characters figured by the authors. In a few cases of close similarity the species have not been separated in the key, and it is necessary to study the other sex or stages of the mite. In order to identify species correctly, it is advisable to study adults of both sexes, as well as nymphs, whenever possible.

KEY TO FEMALES

1. Tarsus II with one terminal rodlike seta 2
   Tarsus II with two terminal rodlike setae 19
2. Hysterosoma with six pairs of marginal setae 3
   Hysterosoma with seven pairs of marginal setae 7
3. Dorsal surface of body reticulate almost in entirety 4
   Dorsal surface of body not reticulate, with only a very few linear markings; markings along margin of body more common; marginal setae long, slender, serrate ..... *edwinae*, new species
4. Dorsal reticulate elements netlike, net not longer than wide 5
   Dorsal reticulate elements quite elongate with only a few cross striae ..... *mcgregori*, new species
5. Reticulations not meeting dorso-medianly on propodosoma; dorsal reticulate elements of hysterosoma wider than long 6
   Reticulations meeting dorso-medianly on propodosoma; dorsal reticulate elements of hysterosoma about as long as wide ..... *chilensis*, new species
6. Reticulate pattern on venter of hysterosoma extends anterior to posterior ventral hysterosomal setae ..... *inornatus* (Banks)
   Reticulate pattern on venter of hysterosoma not extending to the posterior ventral hysterosomal setae ..... *phoenicis* (Geijskes)
7. Rostral shield not reaching past middle of femur I; tip of rostrum reaching only to distal end of femur I; rostrum of normal size, not elongate 8
   Rostral shield reaching almost to distal end of femur I; tip of rostrum reaching almost to distal end of genu I; mouth parts greatly elongate ..... *oleae*, new species
8. Hysterosoma with lateral margins subparallel, converging posteriorly 9
   Lateral margins more or less parallel, front and rear of mite broadly rounded, extra pair of anterior lateral hysterosomal setae present 18
9. Posterior and anterior ventral hysterosomal setae short, of equal length 10
   Posterior ventral hysterosomal setae much longer than anterior pair 11
10. Reticulation covering almost all of dorsal body surface, of same pattern throughout, the elements about as long as wide; reticulate pattern not covering entire venter of mite ..... *oncidii*, new species
    Reticulate patterns not meeting dorsally on propodosoma and on hysterosoma consisting of a few more or less irregular lines; reticulate pattern covers almost entire venter of mite ..... *cuneatus* (Canestrini and Fanzago)
11. Dorsal reticulate pattern not netlike, elements much longer than wide 12
    Dorsal reticulate pattern netlike, elements about as long as wide 13
12. Reticulate pattern between genital plate and posterior ventral hysterosomal setae ..... *garmani*, new species
    No reticulate pattern between genital plate and posterior ventral hysterosomal setae ..... *lewisi* McGregor
13. Hysterosomal marginal setae short, with few serrations 14
    Hysterosomal marginal setae long, reaching about halfway to base of next seta, with many serrations ..... *cardinalis* (Banks)
14. Dorsal setae of femora I and II not as long as width of segment 15
    Dorsal setae of femora I and II as long as width of segment ..... *sayedi*, new species

15. Reticulate pattern extending across entire anterior ventral plate 16
Reticulate pattern only on lateral margins of ventral plate; pattern connected by transverse striae ..... *russulus* (Boisduval)

16. Elements of reticulate pattern of anterior ventral plate wider than long; dorsal hysterosomal reticulate elements, especially medianly, of varying sizes 17
Elements of reticulate pattern of anterior ventral plate about as wide as long; dorsal hysterosomal reticulate elements of equal size ..... *essigi*, new species

17. Dorsal propodosomal reticulate elements netlike across entire surface; femora I and II without large protuberances ..... *lilium*, new species
Dorsal propodosomal reticulate elements broken medianly; femora I and II with one or two prominent protuberances ..... *linki*, new species

18. Posterior ventral hysterosomal setae much longer than anterior pair ..... *pyri* Sayed
Posterior and anterior ventral hysterosomal setae short, of equal length ..... *oudemansi* (Geijskes); *geisenheyeri* (Rübsaamen)

19. With six pairs of hysterosomal marginal setae 20
With seven pairs of hysterosomal marginal setae 22

20. Palpal segment II with a strong inner basal swelling 21
Palpal segment II without strong inner basal swelling ..... *yothersi*, new species; *mcbridei*, new species

21. Marginal setae broadly lanceolate; pattern laterad of coxae II not reticulate but consists of a few short striae ..... *papayensis*, new species
Marginal setae narrowly lanceolate; pattern laterad of coxae II truly reticulate ..... *pseudocuneatus* (Blanchard)

22. Dorsal reticulate pattern truly netlike 23
Dorsal pattern consists of a few longitudinal striae ..... *longisetosus*, new species

23. Reticulate pattern covers entire dorsal surface of propodosoma 24
Reticulate pattern does not cover entire dorsal surface of propodosoma, meeting in center with faint irregular striae ..... *californicus* (Banks); *woglumi* McGregor

24. Reticulate elements in area between anterior ventral plate and posterior ventral hysterosomal setae about as long as wide 25
Reticulate elements in above area wider than long ..... *australis* (Tucker); *confusus*, new species

25. Ventral reticulation between posterior and anterior ventral hysterosomal setae; reticulate elements in area laterad of coxae II longer than wide ..... *trinidadensis*, new species
Ventral reticulation extends only slightly anterior to the posterior ventral hysterosomal setae; reticulate elements in area laterad of coxae II about as long as wide ..... *browningi*, new species

KEY TO DEUTONYMPHS

1. With six[4] pairs of hysterosomal marginal setae 2
With seven[4] pairs of hysterosomal marginal setae 7

2. Marginal setae not of equal length 3
Marginal setae of approximately equal size and length ..... *mcgregori*, new species

3. Marginal setae 2, 3 and 4 of approximately equal size, lanceolate serrate 4
Marginal setae 2, 3 and 4 not of equal size 5

4. Marginal setae 1, 5 and 6 minute, not lanceolate ..... *papayensis*, new species
Marginal setae 1 and 5 not minute but smaller than others and lanceolate serrate ..... *yothersi*, new species

5. Marginal setae 2 and 3 of equal size 6
Marginal setae 1, 2, 5 and 6 minute, serrate, not lanceolate ..... *pseudocuneatus* (Blanchard)

[4] The marginal body setae are numbered, for convenience, from 1 to 10.

6. Marginal setae 1, 4 and 5 equal ..... *inornatus* (Banks)
Marginal setae 1 and 4 equal, more than two times longer than seta 5, seta 6 about two times longer than 5, on citrus at times 4=5=6 or 5=6 ..... *mcbridei*, new species

7. All marginal and dorsal setae not extremely long 8
All marginal and dorsal setae extremely long, much longer than distance between setal bases ..... *salviae* McGregor

8. Marginal setae 7-10 not of equal length 9
Marginal setae 7-10 of equal size and length 14

9. Lateral marginal setae long, reaching base of next posterior setae, especially 2 and 3 10
Lateral marginal setae not long, not reaching base of next setae 11

10. Dorsal surface of body with normal nymphal striation ..... *pyri* Sayed
Dorsal posterior surface of hysterosoma and lateral margin of propodosoma with reticulate pattern ..... *cardinalis* (Banks)

11. Setae of moderate size, never long, whiplike 12
Setae 2, 3 and 8 long, whiplike; seta 10 lanceolate; other setae minute ..... *longisetosus*, new species

12. Rostrum and palpi not extremely long, of normal size 13
Rostrum and palpi extremely long, reaching past distal end of femur I; marginal seta 10 twice as long as 9 (setae 3, 4 and 8 missing, others equal in length to 9) ..... *oleae*, new species

13. Marginal setae 2, 8 and 10 quite large, lanceolate, serrate; other setae minute ..... *garmani*, new species
Marginal seta 8 large, other posterior marginal setae minute ..... *essigi*, new species
Marginal setae 8 and 10 large; other posterior marginal setae minute ..... *trinidadensis*, new species
Marginal setae 1, 2, 3, 4, 5, 7, 8 and 10 large, of equal size; seta 6 small, lanceolate; seta 9 minute, rodlike ..... *linki*, new species

14. All marginal setae (1-10) of approximately equal size and shape 15
Marginal setae (1-10) subequal 16

15. Dorsal and marginal setae of approximately same length ..... *pini*, new species
Marginal setae much larger than dorsal setae ..... *browningi*, new species

16. Setae 2 and 3 of decidedly different size and/or shape 17
Setae 2 and 3 of approximately same shape and either of same size or 3 not more than 1/3 longer than 2 19

17. Setae 3, 4, 7, 8, 9 and 10 lanceolate serrate 18
Setae 3, 7, 8, 9 and 10 decidedly rounded with spinelike serrations ..... *russulus* (Boisduval)

18. Marginal setae 1, 2, 5 and 6 minute, of equal size; setae 3, 4, 7, 8, 9 and 10 large, lanceolate, of equal size ..... *woglumi* McGregor; *lilium*, new species; *confusus*, new species
Marginal setae 1, 2, 5 and 6 shorter than others, 1 the shortest; setae 7, 8, 9 and 10 elongate, drawn out at tip ..... *oncidii*, new species

19. Marginal setae 2, 3 and 4 large and of more or less equal size; setae 1, 5 and 6 small ..... *australis* (Tucker)[5]
Marginal setae as above but seta 2 smaller than 3 ..... *lewisi* McGregor
Marginal setae as in *lewisi* but seta 4 as small as 1 and 5 ..... *californicus* (Banks)

KEY TO MALES

1. Hysterosoma with six pairs of marginal setae 2
Hysterosoma with seven pairs of marginal setae 4

[5] The specimen studied is probably a protonymph.

2. Marginal setae short, not reaching to bases of next setae 3
Marginal setae long, reaching to or surpassing base of next setae (only five pairs setae shown in original figure but pattern indicates that the second pair of hysterosomal setae was not included) .....*grewiae* (Rübsaamen)

3. Margins of body subparallel; marginal setae moderately long and strongly serrate; many small dorsal reticulate elements .....*edwinae*, new species
Margins of body converging to rear as in female; marginal setae short, finely serrate; fewer larger dorsal reticulate elements .....*inornatus* (Banks)

4. Marginal setae long, those on hysterosoma reaching at least to base of next seta 5
Marginal setae short, not reaching more than half way to base of next seta except on posterior margin 7

5. Dorsal setae short 6
Dorsal setae extremely long, reaching much past bases of next setae .....*salviae* McGregor

6. Dorsal body surface reticulate .....*pyri* Sayed
Dorsal body surface without reticulations .....*cardinalis* (Banks)

7. Reticulate pattern covers almost entire surface of dorsum and venter 8
Reticulate pattern only on lateral portion of dorsum, none or very little on venter .....*pini*, new species

8. Reticulate elements netlike, about as long as broad 9
Reticulate elements, especially on propodosoma, many times longer than broad .....*garmani*, new species

9. Marginal setae lanceolate, serrate 10
Marginal, and dorsal, setae clublike, serrate .....*natalensis* (Lawrence)

10. Posterior ventral elements of hysterosoma meeting at center 11
Posterior ventral elements of hysterosoma not meeting at center ....*russulus* (Boisduval)

11. Posterior and anterior ventral hysterosomal reticulate elements of about equal size 12
Anterior ventral hysterosomal elements much smaller than the posterior ventral elements .....*browningi*, new species

12. Hysterosoma constricted at suture 13
Hysterosoma not constricted at suture, form similar to that of female .....*lilium*, new species

13. Hysterosoma strongly constricted at suture; lateral teeth of rostral shield simple .....*oncidii*, new species
Hysterosoma only mildly constricted at suture; lateral teeth of rostral shield paired .....*confusus*, new species

Brevipalpus edwinae, new species

Plate I, Figs. 1-5

Female (Figs. 1, 2 ,5).—Body broadest at or behind suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, not extending past middle of femur I; palpal segment II without inner basal swelling. Rostral shield with a pair of median lobes and two pairs of small lateral lobes. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; marginal setae narrowly lanceolate, serrate, somewhat longer than normal. Dorsal hysterosomal setae simple, not as long as marginal setae. Propodosoma without dorsal reticulation but with a few lateral striae; hysterosoma with a few lateral and dorsal striae. Venter of mite reticulate. On posterior ventral plate reticulate elements wider than long; elements on anterior plate only slightly wider than long; laterad of anterior plate and between plate and posterior ventral

hysterosomal setae the reticulate elements as long as wide. Coxae I and II with few reticulations on outer basal portion; few short striae laterad of coxae II. Posterior ventral hysterosomal setae long, surpassing suture between propodosoma and hysterosoma. Tarsus II with a single rodlike seta. Dorsal setae of femora I and II broadly lanceolate, serrate, about half as long as width of segment. Length of body 216 μ; including rostrum 273 μ; width about 140 μ.

Male (Figs. 3, 4).—Body rather rectangular, only slightly constricted at hysterosomal suture. Rostrum of normal size, not reaching past middle of femur I; palpal segment II without inner basal swelling. Rostral shield short, with three pairs of subequal lobes, the center pair not extending past the others. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; marginal setae lanceolate, serrate, long, reaching about halfway to base of next seta. Dorsum of mite reticulate, elements small, about as long as wide; reticulate elements on posterior of hysterosoma apparently not meeting dorsally. Reticulate pattern covering posterior ventral portion of hysterosoma and between the transverse striae and posterior ventral hysterosomal setae. Venter of propodosoma with few striations. Coxae relatively smooth. Dorsal setae on femur I and II lanceolate, serrate, about as long as width of segment. Length of body 213 μ; including rostrum 260 μ; width 107 μ.

Deutonymph.—Not known.

Type host.—*Eupatorium glabratum.*

Type locality.—Km. 67, Mexico-Cuernavaca Highway, Morelos, Mexico.

Type.—U. S. National Museum No. 1812.

The type female, nine paratypes and two males were collected January 22, 1941 by E. W. Baker. The mite is named for Edwina Pages of Mexico City, Mexico.

Brevipalpus mcgregori, new species
Plate I, Figs. 6-8

Female (Figs. 6, 7).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum slightly longer than usual, extending almost to tip of femur I; palpal segment II with a small inner basal swelling. Rostral shield with a pair of long inner lobes and two pairs of small lateral lobes; central portion of shield with longitudinal striae. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; all marginal setae short, broadly lanceolate, serrate. Dorsal hysterosomal setae short, appear to be simple. Pattern of propodosoma composed of longitudinal striae; pattern of hysterosoma composed of longitudinal striae forming dorsally elongate elements. Reticulate elements of ventral plates wider than long; those in area anterior to plates less so; other elements tend to be longer than wide. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II broadly lanceolate, serrate, about half as long as width of segment. Length of body 246 μ; including rostrum 293 μ; width 166 μ.

Male.—Not known.

Deutonymph (Fig. 8).—Dorsal striations typical. All marginal setae large, lanceolate, serrate; marginal setae 1, 2, 3, 4, 5, 6, 7 and 9 of about equal size; seta 8 slightly smaller. Dorsal hysterosomal setae small, simple.

Type host.—Lemon.

Type locality.—Santa Paula, California.

Type.—U. S. National Museum No. 1813.

The type female, seven paratypes and two nymphs were collected on lemon buds September 14, 1938 by K. E. Maxwell; four paratypes and three nymphs were collected on lemon buds September 8, 1938 by E. W. Baker.

Brevipalpus chilensis, new species
Plate I, Figs. 9, 10

Female (Figs. 9, 10).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum extending to middle of femur I; palpal segment II with sharp inner basal swelling. Rostral shield consisting of a pair of median lobes and two pairs of small lateral lobes; posterior central portion of shield with reticulate design. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; marginal setae short, lanceolate, apparently not serrate. Dorsal hysterosomal setae short and of same size. Reticulate pattern covers dorsal surface of mite, reticulate elements slightly longer than wide. Reticulate elements of ventral plates and area anterior to plates wider than long; reticulate elements laterad of plates about as long as wide. Posterior ventral hysterosomal setae reach to suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II lanceolate, serrate, about half as long as segment is wide. Length of body 267 μ; including rostrum 327 μ; width 167 μ.

Male.—Not known.

Deutonymph.—Not known.

Type host.—Lemon.

Type locality.—Chile (intercepted at New York).

Type.—U. S. National Museum No. 1814.

Described from the type female and two paratypes collected June 14, 1933 by K. W. Holloway, R. D. Kennedy, G. F. Smith and Pablo Ortiz of the Division of Foreign Plant Quarantines in New York on lemons originating in Chile. Eight other specimens were collected on *Vitis vinifera,* September 20, 1909 at Talca, Chile, Collector unknown.

BREVIPALPUS INORNATUS (Banks)
Plate II, Figs. 11-15

Tenuipalpus inornatus Banks, 1912, Proc. Ent. Soc. Wash. 14: 97, pl. 1, fig. 1.
Tenuipalpus bioculatus McGregor, 1914, Ann. Ent. Soc. Amer. 7: 354, text fig. 1, pl. XLII.
Tenuipalpus bioculatus McGregor, 1916, Jour. Econ. Ent. 9: 556, pl. XLIII, fig. 38.

Brevipalpus inornatus (Banks), Baker, 1945, Proc. Ent. Soc. Wash. 47 (2): 33.
Brevipalpus inornatus (Banks), McGregor, 1949, Mem. South. Calif. Acad. Sci. III (2): 13-15, text fig. 4, pl. II.

Female (Figs. 11, 12).—Body broadest at suture between propodosoma and hysterosoma; propodosoma appears short in relation to its width; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, not reaching to middle of femur I; palpal segment II with sharp inner basal swelling. Rostral shield with a pair of long median lobes and two pairs of small lateral marginal lobes; posterior of shield sculptured. Propodosoma with three pairs of short, lanceolate, serrate setae; hysterosoma with six pairs of similar setae. Dorsal hysterosomal setae slightly lanceolate, perhaps serrate, and about as long as marginal setae. Elements of reticulate pattern on propodosoma slightly longer than wide, not meeting dorsally; elements of pattern on hysterosoma varying, those on dorsum wider than long and those laterad of this area longer than wide. Ventral reticulate elements small, on ventral plates and anterior to plates these elements are wider than long. Elsewhere the elements are slightly longer than wide. Posterior ventral hysterosomal setae of normal length, reaching to suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II lanceolate, serrate, almost half as long as width of segment. Length of body 246 μ; including rostrum 286 μ; width 150 μ.

Male (Figs. 13, 14).—Body broadest at propodosoma; hysterosoma with lateral margins converging posteriorly, not constricted at suture. Rostrum of normal size, reaching to middle of femur I; palpal segment II without inner basal swelling. Rostral shield with the two median lobes and two pairs of weak lateral lobes. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; marginal setae short, lanceolate, serrate; the three pairs of dorsal hysterosomal setae are short and slightly lanceolate. Elements of propodosomal reticulate pattern about as long as wide, not meeting dorsally; elements of anterior portion of hysterosoma tend to be longer than wide and do not meet dorsally; elements on posterior portion of hysterosoma tend to be longer than wide except on anterior central portion and meet dorsally. Reticulate pattern on venter of hysterosoma slightly wider than long, covering entire venter; those elements anterior to the hysterosomal suture small, about as long as wide; other elements as figured. Dorsal setae of femora I and II broadly lanceolate, serrate, about half as long as width of segment. Length of body 227 μ; including rostrum 273 μ; width 153 μ.

Deutonymph. (Fig. 15).—Dorsal striations typical. Marginal setae lanceolate, serrate; setae 1, 4, 5 and 6 of equal size, about half as long as others but this may be variable; setae 2, 3, 7, 8 and 9 of equal size; dorsal hysterosomal setae small, simple.

Type host.—Goldenrod.

Type locality.—Batesburg, South Carolina.

Type.—U. S. National Museum No. 1815.

The mite was originally described from goldenrod; the type of *bioculatus*, a synonym, was found on privet in the same locality. McGregor, 1916, records

it on privet in Florida, South Carolina, Alabama, Mississippi, and Louisiana. Mites determined as this species have been collected on begonia, Main; Japanese honeysuckle, South Carolina; *Phoenix humilis*, Louisiana; *Gerbera* sp., Ontario, Canada; *Osbeckia?*, Maryland; Ponderosa lemon, Italy? at Brownsville, Texas; *Citharexylum quadrangularis*, Missouri. Ten females, two nymphs and two larvae were also collected in tulip bulbs originating in Japan, at Seattle, Washington; these cannot be separated at present from *inornatus*. The description of the male is based on specimens collected on honeysuckle, Batesburg, South Carolina. Specimens of what appears to be this species from citrus in Australia and Azalea in California and Oregon tend to have larger marginal setae 1, 4, 5 and 6 in the nymphal stages. A few specimens of the east coast privet forms have the tendency to vary in the same manner but not as much. An *inornatus* type nymph was found in material from tea, Ceylon sent in by C. D. Gadd. Numerous specimens of the typical east coast form were collected on potatoes in the insectary at the Citrus Experiment Station, Riverside, California, February 26, 1948 by Blair Barlett.

BREVIPALPUS PHOENICIS (Geijskes)

Plate II, Figs. 16, 17

Tenuipalpus phoenicis Geijskes, 1939, Medeleelingen van de Landbouwhoogeschool, Wageningen, Nederland, Deel 42, Ver. 4: 23, 24, fig. 8.

Until nymphal forms of *phoenicis* can be studied the exact status of the species cannot be determined since the differentiation between the adult females of *phoenicis* and *inornatus* is so poor that it is somewhat doubtful that the two can be really separated.

Type host.—Palm.

Type locality.—Netherlands. Specimens not seen.

BREVIPALPUS PEREGER Donnadieu

Plate II, Figs. 18, 19

Brevipalpus pereger Donnadieu, 1875, Recherches pour servir à l'histoire des Tetranyques. Lyon, p. 116, pl. V, fig. 49.

Type host.—*Rubus* and *Rosa* leaves.

Type locality.—France.

Oudemans, 1929, Ent. Ber. VII: 395, 396, gave a short description, without figures, of "*Brevipalpus pereger*" from an orchid, Java. This is probably a misidentification.

BREVIPALPUS PULCHER (Canestrini and Fanzago)

Plate II, Fig. 20

Tenuipalpus pulcher Canestrini and Fanzago, 1876, Academia Scientifica Veneto. Trentino Istriana. Atti 5: 134, 135.

Caligonus pulcher Canestrini and Fanzago, 1877, Ist. Veneto di Sci. Let., ed Arti. Atti 4(5): 156.

Tenuipalpus pulcher Canestrini and Fanzago, Berlese, 1887, Acari, Myr. Scorp: Ital. Prostigmata, fasc. LXXII, no. 3.

Tenuipalpus pulcher Canestrini and Fanzago, Canestrini, 1890, Prosp. Acarof. Ital. IV: 455.

The figure given by Canestrini, 1890, indicates this to be a male; the figure by Berlese, 1887, appears to be that of a nymph.

Type host.—Hedge.

Type locality.—Trevigiano, Italy.

Brevipalpus oleae, new species
Plate III, Figs. 21-23

Female (Figs. 21, 22).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum elongate, reaching almost to distal end of genu I; palpi also elongate, segment II straight, not swollen at base. Rostral shield elongate, reaching past middle of femur I, with a pair of long median lobes and a pair of short lateral lobes. Shield with few long longitudinal striae. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae short, lanceolate, not appearing to be serrate but this may be due to the mounting. Dorsal hysterostomal setae similar to marginal setae. Reticulate pattern covers dorsum of mite, not meeting on anterior portion of propodosoma; reticulate elements in general are slightly longer than broad except between posterior pair of dorsal hysterosomal setae where they are wider than long. Reticulate elements of ventral plates wider than long; not meeting centrally anterior to plates; in general rest of ventral elements longer than wide. Posterior ventral hysterosomal setae reach to suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II lanceolate, probably serrate, shorter than half the width of the segment. Length of body 266 μ; including rostrum 346 μ; width 167 μ.

Male.—Not known.

Deutonymph (Fig. 23).—Dorsal striations typical. Rostrum, as in adult, quite elongate. Marginal seta 10 two times as long as 9; setae 3, 4 and 8 missing, other setae equal in length to 9; all marginal setae lanceolate and perhaps serrate. Dorsal hysterosomal setae short, simple.

Type host.—Olive.

Type locality.——Morocco?

Type.—U. S. National Museum No. 1816.

The type female and a larva were collected on olive cutting, February 20, 1933 by W. B. Wood; a paratype, a nymph and a larva were collected in crevices of olive bark, March 31, 1930 by W. B. Wood; the collections were made in Washington, D. C. from material originating in Morocco.

Brevipalpus oncidii, new species
Plate III, Figs. 24-30

Female (Figs. 24, 25, 29).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum reaching almost to middle of femur I; palpal segment II without inner basal swelling. Rostral shield with a pair of long median lobes and a pair of short lateral lobes, with striae and reticulation on posterior portion.

Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs; marginal setae short, strong, lanceolate, serrate. Dorsal hysterosomal setae short, strong, but weaker than marginal setae, and perhaps slightly serrate. Reticulate patern covers dorsum of mite; reticulate elements tend to be longer than wide except on dorsal posterior portion of hysterosoma. Reticulate elements of ventral plates much wider than long; elements in other regions longer than wide; in area below coxae II reticulate elements about as long as wide. Posterior ventral hysterosomal setae short, no longer than anterior setae. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II shorter than half the width of the segment, stout, serrate. Length of body 313 μ; including rostrum 367 μ; width 193 μ.

Male (Figs. 26, 27, 30).—Body more or less typical of sex, broadest at suture between propodosoma and hysterosoma, constricted at hysterosomal suture; posterior lateral margins of hysterosoma subparallel, giving the rear of the mite a squarish appearance. Rostrum normal, not extending past middle of femur I, palpal segment II thick but not swollen at base. Rostral shield with a pair of long median lobes and a pair of small lateral lobes, punctate, with striae on center portion and a reticulate pattern on extreme posterior portion. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; propodosomal marginal setae and anterior two pairs of hysterosomal marginal setae short, stout, serrate; posterior marginal setae broader. Dorsal hysterosomal setae short, serrate, not as strong as marginal setae. Reticulate pattern covers dorsum of mite; reticulate elements tend to be slightly longer than wide except in the posterior portion of hysterosoma where they are wider than long. Ventral posterior portion of hysterosoma covered with reticulate pattern whose elements are longer than wide; anterior to transverse striations elements slightly wider than long. On propodosoma central connecting elements wider than long; elements below coxae II about as long as wide; lateral elements longer than wide. Posterior ventral hysterosomal setae of medium length, not reaching bases of anterior pair. Dorsal setae of femora I and II short, strong, serrate, about half as long as width of segment. Length of body 240 μ; including rostrum 293 μ; width 146 μ.

Deutonymph (Fig. 28).—Dorsal skin striation typical. Marginal setae 3, 4, 7, 8, 9 and 10 long, serrate; marginal setae 1, 2, 5 and 6 short, serrate, seta 1 shorter than others. Dorsal hysterosomal setae short, serrate.

Type host.—*Oncidium* sp.

Type locality.—Jarvisbrook, England.

Type.—U. S. National Museum No. 1817.

The type female, four males and a nymph were collected on *Oncidium*, originating at Jarvisbrook, England, by members of the Plant Quarantine Control Administration. No other information available. Three paratypes, two males and five nymphs were collected on *Odontoglossum* leaf originating in England at Hoboken, June 4, 1946 by J. M. R. Adams.

Brevipalpus garmani, new species

Plate IV, Figs. 31-35

Tenuipalpus lineola (Canestrini and Fanzago), Garman, 1923, Conn. Agr. Expt. Stat. Bull. 247: 339 (misidentification).

Tenuipalpus bioculatus McGregor, Garman, 1940, Conn. Agr. Expt. Sta. Bull. 431: 71-73 (misidentification).

Female (Figs. 31, 32).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, reaching to middle of femur I; palpal segment II with inner basal swelling. Rostral shield with a pair of long median lobes and a pair of smaller lateral lobes which occasionally may be cleft. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae slightly lanceolate, serrate, those on propodosoma slightly longer than those on hysterosoma. Dorsal hysterosomal setae about same length as marginal setae, simple. Reticulate pattern on dorsum of propodosoma does not meet medianally; reticulate elements longer than wide. Pattern on hysterosoma with dorsomedian elements wider than long, irregular; the few lateral elements are longer than wide; many longitudinal striations. Reticulate pattern of ventral plates with elements wider than long; elements anterior to plates slightly wider than long; reticulate elements on coxae II about as long as wide; other ventral reticulate elements longer than wide. Posterior ventral hysterosomal setae reach to suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II lanceolate, serrate, about half as long as segment is wide. Length of body 287 μ; including rostrum 340 μ; width 187 μ.

Male (Figs. 33, 34).—Body broadest at propodosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, reaching to middle of femur I; palpal segment II without inner basal swelling. Rostral shield with two pairs of rounded lobes as figured; posterior of shield with few striations. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae lanceolate, serrate; the pair anterior to the eyes appear to be longer than others; the posterior pair more broadly lanceolate. The dorsal hysterosomal setae about as long as the marginal setae and appear to be simple. Propodosoma with a dorsal skin pattern of more or less subparallel striations, occasionally with cross striations; hysterosoma with reticulate pattern in which the elements are longer than wide. Reticulate pattern on venter of hysterosoma with elements slightly wider than long. Base of coxae II and area laterad of coxae II with reticulate elements longer than wide. Dorsal setae of femora I and II broadly lanceolate, serrate, longer than one half the width of the segment. Length of body 233 μ; including rostrum 287 μ; width 146 μ.

Deutonymph (Fig. 35).—Dorsal striations typical, without reticulate pattern. Marginal setae 1, 3, 4, 5, 6, 7 and 9 minute, simple; setae 2, 8 and 10 large, lanceolate, serrate, 8 and 10 perhaps longer than 2. Dorsal hysterosomal setae minute, simple.

Type host.—Elder.

Type locality.—Hamden, Connecticut.

Type.—U. S. National Museum No. 1818.

Described from the type female, twenty-two paratype females, three males and eleven nymphs. These were collected on elder leaves by Philip Garman at Hamden, Connecticut, September 21 and 25, 1922 and at Cheshire, Connecticut, September 3, 1939. Paratypes will be deposited at the Agricultural Experiment Station, New Haven, Connecticut.

Garman (1940) lists the hosts as elderberry, *Sambucus*, and Joe-pye-weed (*Eupatorium*). He states "The damage to the host appears as a sort of reddening of the foliage."

BREVIPALPUS CUNEATUS (Canestrini and Fanzago)

Plate IV, Figs. 36, 37

Caligonus cuneatus Canestrini and Fanzago, 1876, Atti Soc. Veneto-Trentina Sci. Naturali, 5: 136.

Caligonus cuneatus Canestrini and Fanzago, 1877, Ist. Veneto di Sci. Let., ed Arti. Atti 4(5): 157.

Tenuipalpus cuneatus (Canestrini and Fanzago), Berlese, 1887, Acari, Myr. Scorp. Ital., fasc. 35, no. 1.

Tenuipalpus cuneatus (Canestrini and Fanzago), Geijkes, 1939, Mededeelingen van de Landbouwhoogeschool, Wageningen, Nederland, Deel 42, ver. 4: 26.

Female (Figs. 36, 37).—Mounted specimens broad, egglike, broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum not reaching past middle of femur I; palpal segment II without inner basal swelling. Rostral shield appears as figured, with a median pair of lobes of medium length and a pair of small lateral lobes; posterior of shield reticulate. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae short, lanceolate, serrate, the 7th and 8th and 9th and 10th marginal setae are paired. Dorsal hysterosomal setae short, lanceolate, apparently not serrate. Dorsal reticulate pattern somewhat irregular; on propodosoma lateral elements longer than wide and on the anterior portion where the pattern meets dorsally the elements are wider than long; on posterior portion of propodosoma the reticulate pattern does not appear to meet dorsally. On hysterosoma the reticulate pattern is more indefinite; on the dorsal surface the elements are broken and are wider than long; on the lateral margins just outside the dorsal setae the few reticulate elements are longer than wide. Entire venter covered with reticulate patern; reticulate elements of posterior ventral plate much wider than long; reticulate elements of anterior plate slightly wider than long; other reticulate elements except those on posterior center of propodosoma tend to be longer than wide. Posterior ventral hysterosomal setae short, no longer than the anterior setae. Tarsus II with a long rodlike sensory seta. Dorsal setae of femora I and II short, lanceolate serrate, about half as long as the width of the segment. Length of body 267 μ; including rostrum 325 μ; width 200 μ.

Male.—Not known.

Deutonymph.—Not known.

Type host.—Leaves of hedge.

Type locality.—Italy.

The above redescription was made from two females deposited in the U. S. National Museum, collected in Portici, Italy and from the Berlese collection. These were identified by Berlese as this species.

BREVIPALPUS LEWISI McGregor

Plate IV, Figs. 38, 39, Plate V, Fig. 40

Tenuipalpus sp., Lewis, 1944, Calif. Citrograph 29 (4): 87.

Brevipalpus lewisi McGregor, 1949, Mem. So. Calif. Acad. Sci. 3 (2): 17-19, text fig. 6, pl. IV.

Female (Figs. 38, 39).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Mouth parts of normal size, not extending past middle of femur I; palpal segment II with slight inner basal swelling. Rostral shield with a pair of long median lobes, and a pair of large but smaller lateral lobes which are notched in some specimens. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae short, slightly lanceolate, serrate. The three pairs of dorsal hysterosomal setae slightly lanceolate, and possibly faintly serrate. Reticulate pattern on propodosoma not meeting dorsally, elements much longer than wide. Elements of reticulate pattern on hysterosoma also much longer than wide. Reticulate elements on ventral shields much wider than long; anterior to shields reticulate pattern faint towards center, possibly not meeting; rest of reticulate pattern with elements longer than wide. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II lanceolate, serrate, about half as long as width of segment. Length of body 246 μ; including rostrum 280 μ; width 153 μ.

Male.—Not known.

Deutonymph (Fig. 40).—Dorsal striations typical. Marginal setae 1, 5, and 6 short, lanceolate, serrate, 1 probably smaller than others; marginal setae 2, 3, 4, 7, 8, 9 and 10 large, lanceolate serrate, 2 and 4 of equal size and appear to be slightly smaller than 3, 7, 8, 9 and 10 which are of equal size. Dorsal hysterosomal setae short and simple.

Type host.—Lemons.

Type locality.—Porterville, California.

Type.—U. S. National Museum No. 1527.

The type specimens were collected by H. C. Lewis December 11, 1942. Redescribed from types.

BREVIPALPUS CARDINALIS (Banks)

Plate V, Figs. 41-45

Tenuipalpis cardinalis Banks, 1912, Proc. Ent. Soc. Wash. XIV: 96, 97, pl. I, fig. 8.

Brevipalpus cardinalis (Banks), McGregor, 1949, Mem. South. Calif. Acad. Sci. III (2): 15-17, text. fig. 5, pl. III.

Female (Figs. 41, 42).—Body broadest at or slightly behind suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum long, reaching to or past distal end of femur I; palpal segment II without inner basal swelling. Rostral shield with two long median lobes and a pair of small simple lateral lobes as figured; posterior portion of shield with some sculpturing. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all setae long, stout, and strongly serrate. The three pairs of dorsal hysterosomal setae strongly serrate, almost as long as marginal setae. Propodosoma covered with reticulate pattern, the elements of which, in general, are about as long as wide. The dorsal hysterosomal reticulate pattern varies greatly as figured. Posterior ventral plate with reticulate pattern in which the elements are wider than long; anterior plate and region anterior to plate with pattern in which the elements are much wider than long. Reticulate elements laterad of ventral plates perhaps slightly longer than wide; other reticulate elements longer than wide. Coxae I and II and venter of propodosoma with few transverse striations; region laterad of coxae II appears free of any pattern. Posterior ventral hysterosomal setae reaching past suture between propodosoma and hysterosoma; anterior ventral hysterosomal setae almost as long as posterior pair. A single rodlike sensory seta on tarsus II. Dorsal setae of femora I and II strongly serrate, about as long as length of segment. Length of body 246 μ; including rostrum 280 μ; width 146 μ.

Male (Figs. 44, 45).—Body broadest at posterior margin of propodosoma; narrowing gradually to rear, no constriction at either suture. Rostrum of normal size, reaching only to middle of femur I; palpal segment II without inner basal swelling. Rostral shield short, with two median lobes and a pair of weak lateral lobes. Marginal setae as in female, long, strongly serrate; three pairs of setae on propodosoma and seven pairs on hysterosoma. Dorsal hysterosomal setae much shorter and smaller than marginal setae, serrate. Dorsal surface of body smooth and covered with many small tubercles; with eight pairs of pores as figured. Venter of mite appears to be smooth except for the striae behind coxae IV. Dorsal setae of femora I and II serrate, about as long as segment. Length of body 217 μ; including rostrum 233 μ; width 113 μ.

Deutonymph (Fig. 43).—The striate pattern is present but there is also a reticulate pattern on the propodosoma and posterior portion of the hysterosoma; that on the propodosoma does not meet dorsally while the hysterosomal pattern covers the entire posterior central portion of the mite. Marginal setae 1 to 7 long, serrate, 1, 5, 6 and 7 appear slightly longer than 2, 3 and 4; marginal setae 8, 9 and 10 short, broadly lanceolate, serrate, seta 8 shorter than 9 and 10.

Type host.—Ash.

Type locality.—Phoenix, Arizona.

Redescribed from specimens collected on ash at Bakersfield, California, September 11, 1944 by C. S. Morlan. Location of type not known.

Brevipalpus essigi, new species
Plate V, Figs. 46-48

Female (Figs. 46, 47).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum longer than usual, reaching to distal end of femur I; palpal segment II without inner basal swelling. Rostral shield with two long median lobes and three pairs of small lateral lobes; with very few longitudinal markings. Propodosoma with three pairs of serrate marginal setae, the anterior pair the strongest. Hysterosoma with seven pairs of slightly serrate setae, all slightly shorter than the posterior pair on the propodosoma. Dorsal hysterosomal setae about as long as marginal setae but finer and probably not serrate. Reticulate pattern covers dorsal surface of mite; in general the reticulate elements on the propodosoma are about as long as wide, and those on the hysterosoma are slightly longer than wide. Reticulate pattern on posterior ventral plate with elements which are much wider than long; those on the anterior plate are about as wide as long. The reticulate elements of rest of venter, except those laterad of coxae II which are longer than wide, about as long as wide. Posterior ventral hysterosomal setae almost reaching suture between propodosoma and hysterosoma. Tarsus II with one rodlike sensory seta. Dorsal seta on femora I and II strongly serrate, reaching end of segment, that on femur I the larger. Length of body 280 μ; including rostrum 340 μ; width 166 μ.

Male.—Not known.

Deutonymph (Fig. 48).—Dorsal striations typical, as figured. Setae 1, 3 and 8 large, 1 being the largest, and 3 and 8 smaller; 2 and 4 smaller than 3 and of about equal size; 5, 6, 7, 9 and 10 of about same size, smaller than others; all setae serrate. Dorsal hysterosomal setae of equal size, simple, about as long as marginal setae 6 and 7.

Type host.—*Acuba* sp.

Type locality.—Berkeley, California.

Type.—U. S. National Museum No. 1819.

The type female and one paratype were collected on *Acuba* sp., Berkeley, California, January 28, 1938 by E. W. Baker. Two paratypes and five nymphs were collected on a vine, *Ficus* sp., at Berkeley, California, March 9, 1938 by E. W. Baker.

Brevipalpus sayedi, new species
Plate VI, Figs. 49, 50

Female (Figs. 49, 50).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging slightly posteriorly. Rostrum slightly longer than normal, reaching to distal end of femur I; palpal segment II long, without inner basal swelling. Rostral shield simple, with only a pair of median lobes; posterior of shield strongly sculptured. Propodosoma with three pairs of long simple marginal setae, the anterior pair the longest. Hysterosoma with seven pairs of shorter, simple setae; if these marginal setae are serrate they are only slightly so and cannot be seen in the prepara-

tions. Dorsal hysterosomal setae simple, short. Dorsal reticulate pattern as figured; reticulate elements varying in length and width; reticulate pattern not well defined on anterior central portion of propodosoma; on hysterosoma reticulate pattern as figured. On venter of mite pattern tends to be of transverse striations on all portions except laterad of ventral plates and coxae II where the reticulate elements are longer than wide. Posterior ventral hysterosomal setae of normal length, reaching past suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory setae. Dorsal setae on femora I and II broadly lanceolate, serrate, longer than width of segment and reaching past distal tip of segment. Length of body 200 μ; including rostrum 240 μ; width 120 μ.

Male.—Not known.

Deutonymph—Not known.

Type host.—Hickory.

Type locality.—Monticello, Florida.

Type.—U. S. National Museum No. 1820.

The type female and five paratypes were collected on hickory, December 8, ----?, by J. B. Gill. Thirteen paratypes were collected on hickory bud, Gainesville, Florida, February 18, 1914 by ..... Scammell. Many overwintering females were collected on hickory buds at Beltsville, Maryland, April 10, 1947 by E. W. Baker.

BREVIPALPUS RUSSULUS (Boisduval)

Plate VI, Figs. 51-55

Acarus russulus Boisduval ,1866, Essai Entom. horticole, pp. 89, 90.
Tenuipalpus cactorum Oudemans, 1929, Ent. Ber. 7 (168): 483-484.
Brevipalpus russulus (Boisduval), Oudemans, 1938, Tyd. Ent. LXXXI, Verslag LXXIII.
Tenuipalpus cactorum Oudemans, Geijskes, 1939, Mededeelingen van de Landbouwhoogeschool Wageningen, Nederland, Deel 42, ver. 4: 24, 25, fig. 9.
Tenuipalpus russulus (Boisduval), Cooreman, 1947, Bull. & Annals Soc. Ent. Belgique, 83: 43.

Female (Figs. 51, 52).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Mouth parts of normal size, rostrum reaching slightly past middle of femur I; palpal segment II without inner basal swelling. Rostral shield with two long median lobes and two pairs of small lateral lobes. Propodosomal with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae not lanceolate but spinelike with few serrations. The three pairs of dorsal hysterosomal setae are of equal length, appear simple, and are about as long as the marginal setae. The reticulate pattern covers dorsum on the propodosoma; the elements, are, in general, longer than wide; on the hysterosoma the elements are perhaps longer than wide except between the dorsal setae where they are wider than long. The reticulate pattern on posterior ventral plate consists of elements wider than long; on the anterior plate the lateral elements are small, about as long as wide, while the central elements appear to be much wider than long. Likewise, the reticulate elements anterior to the ventral plates are wider than long and extend anterior to the posterior ventral hysterosomal

setae. Laterad of the ventral plates the reticulate elements are longer than wide; laterad of coxae II reticulate elements about as long as wide. Coxae I with few transverse striae; coxae II with reticulate pattern on basal outer portion. Posterior ventral hysterosomal setae almost reach suture between propodosoma and hysterosoma. Tarsus II with a single terminal rodlike sensory seta of medium length. Dorsal setae on femora I and II spinelike, with few serrations, about half as long as segment is wide. Length of body 280 μ; including rostrum 327 μ; width 173 μ.

Male (Figs. 53, 54).—Broadest at suture between propodosoma and hysterosoma; constricted at hysterosomal suture; posterior of hysterosoma rounded. Rostrum reaching to middle of femur I; palpus without inner basal swelling. Rostral shield with two pairs of lobes of about equal length. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all setae lanceolate, serrate, those on propodosoma only slightly so while those on posterior of hysterosoma much more so. Dorsal reticulate pattern covering most of propodosoma and hysterosoma, the reticulate elements as a whole, perhaps longer than wide. Reticulate pattern on posterior venter of mite with elements longer than wide, not meeting in center. Few striations and reticulations on coxae I and II; reticulate elements laterad of coxae II slightly longer than wide. Dorsal setae of femora I and II slender, serrate, about half as long as segment is wide. Length of body 227 μ; including rostrum 267 μ; width 127 μ.

Deutonymph (Fig. 55).—Dorsal skin pattern normal as figured. Marginal setae 3, 7, 8, 9 and 10 of equal size, broadly squamiform with long serrations; marginal setae 1, 2, 4, 5 and 6 of equal size, small with few serrations, setae 1, 2 and 4 with lateral serrations and setae 5 and 6 merely split at tip. Dorsal hysterosomal setae of same size as the small marginal setae, the first two pairs are similar to marginal setae 1, 2 and 4 and the posterior pair is similar to marginal setae 5 and 6.

Type host.—Cactus.

Type locality.—Germany.

The female and nymph were redescribed and figured from material collected on *Lobivia rebutioides* from Peru, collected at Washington, D. C., June 23, 1936 by J. M. R. Adams. The male was redescribed from material collected on "cactus plants" from Germany at Washington, D. C., July 25, 1936 by H. Y. Gouldman. Material was also collected on *Echinocactus lafaldensis* from Argentina at Washington, D. C., November 23, 1936 by W. B. Woods. Geijskes (1939) lists it as feeding on cacti and succulents in Holland.

Brevipalpus lilium, new species

Plate VI, Figs. 56, 57; Plate VII, Figs. 58-60

Female (Figs. 56, 57).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, reaching slightly past middle of femur. Palpal segment II with perhaps a slight inner basal swelling. Rostral shield with a pair

of long median lobes and a pair of short lateral lobes which may at times be slightly notched. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae short, narrowly lanceolate, serrate. Dorsal hysterosomal setae about same as marginal setae but do not appear to be serrate. Reticulate pattern covers propodosoma; reticulate elements longer than wide; elements of reticulate pattern on hysterosoma longer than wide except on dorsoposterior portion where they are wider than long. Elements of reticulate pattern on ventral plates much wider than long; those anterior to ventral plates slightly wider than long. Elsewhere reticulate elements longer than wide. Posterior ventral hysterosomal setae of normal length, reaching to suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II lanceolate, serrate, slightly longer than half the width of the segment. Length of body 286 μ; including rostrum 350 μ; width 200 μ.

Male (Figs. 58, 59).—Broadest at suture between propodosoma and hysterosoma; body narrowing to rear, not constricted at hysterosomal suture. Rostrum of normal size, not extending past middle of femur; palpal segment II without inner basal swelling. Rostral shield not distinctly visible, possibly as figured. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of setae; marginal setae of medium length, slightly lanceolate, serrate. Dorsal hysterosomal setae perhaps slightly lanceolate, not serrate. Reticulate pattern covers dorsum of mite; reticulate elements slightly longer than wide on propodosoma and distinctly so on hysterosoma. On venter of hysterosoma reticulate elements tend to be wider than long in center and longer than wide on lateral margins. Venter of propodosoma with many transverse striae as figured. Dorsal setae of femora I and II slightly lanceolate, serrate, not as long as width of segment. Length of body 213 μ; including rostrum 246 μ; width 133 μ.

Deutonymph (Fig. 60).—Dorsal skin pattern typical. Marginal setae 1, 2, 5 and 6 small, serrate, 2 perhaps slightly longer than the others; marginal setae 3, 4, 7, 8, 9 and 10 large, lanceolate, serrate. Dorsal hysterosomal setae short and simple.

Type host.—*Lilium regale*.

Type locality.—Mabton, Washington.

Type.—U. S. National Museum no. 1821.

The type female, thirty-two paratypes, one male and two nymphs were collected by F. P. McWhorter, September 26, 1938.

Brevipalpus linki, new species

Plate XIV, Figs. 125-127

Female (Figs. 125, 126).—Body broadest just behind suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly, but not strongly. Rostrum of normal size, not extending past middle of femur I; palpal segment II without inner basal swelling and with somewhat broader seta than normal. Rostral shield with a pair of long median

lobes and a pair of lateral lobes, both pairs may or may not be slightly notched. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae short, broadly lanceolate, serrate. Dorsal hysterosomal setae small, slightly lanceolate. Reticulate elements of propodosoma about as long as wide except dorsally where the pattern is very irregular; reticulate elements of hysterosoma irregular, tending to be wider than long dorsally. Reticulate elements of ventral plates slightly wider than long; other ventral elements tend to be slightly longer than wide. Posterior ventral hysterosomal setae not reaching to suture between propodosoma and hysterosoma. Tarsus II with a single rodlike sensory seta. Dorsal setae of femora I and II short, broadly lanceolate; femur I with two prominent basal protuberances; femur II with one prominent protuberance. Length of body 226 μ; including rostrum 280 μ; width 167 μ.

Male.—Not known.

Deutonymph (Fig. 127).—Dorsal striations typical. Most marginal setae large, lanceolate, serrate; setae 1, 2, 3, 4, 5, 7, 8 and 10 large, lanceolate, serrate, of equal size; marginal setae 6 short, less than one-third as long as others, lanceolate, serrate; marginal seta 9 minute, rodlike. Dorsal hysterosomal setae short, simple.

Type host.—Live oak, on leaf.

Type locality.—Orlando, Florida.

Type.—U. S. National Museum No. 1822.

The type female, two paratype females and four nymphs were collected on live oak leaf at Orlando, Florida, January 30, 1948 by O. D. Link for whom the mite is named.

BREVIPALPUS OUDEMANSI (Geijskes)
Plate VII, Figs. 61, 62

Tenuipalpus oudemansi Geijskes, 1939, Mededeelingen van de Landbouwhoogeschool, Deel 42, ver. 4: 25, 26, fig. 7.

Figures 7, 8 and 9 of Geijskes should read as follows and not as printed in his paper: Fig. 7, *oudemansi;* Fig. 8, *phoenicis;* Fig. 9, *cactorum.*

Type host.—Apple.

Type locality.—Holland.

BREVIPALPUS PYRI Sayed
Plate VII, Figs. 63-66; Plate VIII, Fig. 67

Tenuipalpus oudemansi Geijskes, Sayed, 1942, Bull. Soc. Fouad 1er Ent. XXVI: 94-96, pls. I, II (misidentification).

Brevipalpus pyri Sayed, 1946, Bull. Soc. Fouad 1er Ent. XXX: 100, 102, 103.

Female (Figs. 63, 64).—Body rounded anteriorly and posteriorly; lateral margins almost parallel, as in *oudemansi* and *geisenheyeri.* Rostrum normal, not reaching much past middle of femur I; palpal segment II without inner basal swelling. Rostral shield simple, with a pair of median lobes only; shield covered with scalloplike reticulations. The three pairs of propodosomal marginal setae are long, serrate, the first pair longer than others; hysterosoma with seven pairs of marginal setae, about half as long as posterior pair of propodo-

somal setae; there is an extra pair of such setae a short distance in from the first pair of hysterosomal marginal setae. The three pairs of dorsal hysterosomal setae simple, about as long as the marginal setae. Reticulate pattern covers entire dorsum, elements about as long as wide except on dorsocentral portion of hysterosoma where they are wider and long. Reticulate elements of ventral plates slightly wider than long; those anterior and laterad of plates about as long as wide. Venter of propodosoma with few transverse striations. Posterior ventral hysterosomal setae extend to suture between propodosoma and hysterosoma. Tarsus II with a single, long, slender rodlike sensory seta. Dorsal setae of femora I and II slightly lanceolate, serrate, longer than half the width of the segment. Length of body 280 μ; including rostrum 313 μ; width 173 μ.

Male (Figs. 65, 67).—Not seen, figures after Sayed, 1942.

Deutonymph (Fig. 66).—Dorsal striations simple, typical. Most marginal setae are missing on the only available specimen. However, marginal setae 2, 3 and 6 are large, long, serrate; marginal seta 7 short, apparently lanceolate and possibly serrate. Dorsal hysterosomal setae shorter than marginal set 7 and simple.

Type host.—Apples, pears, plums, apricots and others.

Type locality.—Egypt.

Mites in the U. S. National Museum have been collected as follows: on cherry buds, originating in Italy, New York, April 6, 1933 by Ralph Shemin, F. O. Dodd, et al.; on Sorbus apple leaf originating in Italy, at New York, January 18, 1932 by J. R. Garret and O. G. Fitzgerald; on apple scion, originating in Italy, at Washington, D. C., February 27, 1930 by H. Y. Gouldman; on apple originating in England, April 7, 1913 (no other data); or. *Malus* sp. originating in Algeria, at Washington, D. C., March 6 and 7, 1932 by L. L. Spessard and W. B. Wood; on walnut bark originating in Sicily, at Washington, D. C. (no other data); on Cotoneaster originating at Taunton, England at San Francisco, April 10, 1945 by R. L. Howard; and on *Salix discolor* originating in Denmark, at New York, April 5, 1946 by E. A. Prentiss.

Brevipalpus donnadieui (Oudemans), new combination

Plate VIII, Figs. 68-70

Tenuipalpus glaber Donnadieu, 1875, Recherches pour servir à l'histoire des Tetranyques, Lyon, pp. 114-115, pl. IV, figs. 31-42.

Tetranychus lineola Canestrini and Fanzago, 1876, Academia Scientifica Veneto. Trentino Istriana Atti 5, fasc. 1, p. 105.

Caligonus lineola Canestrini and Fanzago, 1877, Ist. Veneto di Sci. Let., ed Arti. Atti 4(5): 153, 154, pl. V, fig. 2.

Caligonus glaber Donnadieu, 1877, Ibid., 4(5): 154.

Tenuipalpus lineola Canestrini and Fanzago, Canestrini, 1890, Prosp. Acarof. Ital. IV: 453, 454.

Tenuipalpus lineola Canestrini and Fanzago, Berlese, 1893, Acari, Myr. Scorp. Ital. Prostigmata, p. 56.

Flexipalpus donnadieui Oudemans, 1938, Tijd. v. Ent. 81, verslag LXXIII.

Tenuipalpus glaber Donnadieu, Geijskes, 1939, Mededeelingen van de Landbouwhoogeschool, Nederland, Deel 42, ver. 4: 26.

Canestrini, in 1890, placed the species *cuneatus* into synonymy with *lineola;* Berlese, 1893, placed *lineola* into synonymy with *glaber* and figured *cuneatus* as a distinct species. The figure of *lineola* as given by Canestrini in 1890 indicates that Berlese is correct. Oudemans (1938) states that Donnadieu identified his *glaber* with *Trombidium glabrum* Dugés which is actually a *Caligonus*. thus leaving Donnadieu's species without a name. Oudemans proposed the name *Flexipalpus donnadieui* for this species. *Flexipalpus* Scheuten, 1857 was believed by Oudemans to be identical with *Tenuipalpus* Donnadieu, but from the examination of the original figures illustrating the genus I am convinced that it is an eriophyid.

Type host.—*Rubus fructiosus* and *Rosa canina.*

Type locality.—France.

Geijskes, 1939, lists *Rubus fructicosus, R. idaeus,* and *Rosa rubiginosa* as hosts.

BREVIPALPUS GEISENHEYERI (Rübsaamen)

Plate VIII, Figs. 71, 72

Tenuipalpus geisenheyeri Rübsaamen, 1910, Zs, Wiss. Insektenbiol. 6: 127-189, fig. 2.

Type host.—*Cornus sanguinea* L.

Type locality.—Germany.

BREVIPALPUS OBOVATUS Donnadieu

Plate VIII, Figs. 73-75

Brevipalpus obovatus Donnadieu, 1875, Recherches pour servir à l'histoire des Tetranyques. Lyons. P. 116, pl. V. figs. 43-52.

The figures and description are not detailed enough to recognize the species.

Type host.—*Phytolacca* and *Primula veris.*

Type locality.—France.

BREVIPALPUS SPINOSUS (Donnadieu)

Plate IX, Figs. 76-77

Tenuipalpus spinosus Donnadieu, 1875, Recherches pour servir à l'histoire des Tetranyques. Lyon, p. 114, pl. III, figs. 20-30.

Type host.—*Viburnum tinus.*

Type locality.—France.

Brevipalpus yothersi, new species

Plate IX, Figs. 78-80

Female (Figs. 78, 79).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, extending slightly past middle of femur; palpal segment II without inner basal swelling. Rostral shield with a pair of long median lobes and a pair of lateral lobes, striate on posterior portion. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae of medium length, lanceolate, serrate. Dorsal hysterosomal setae slightly lanceolate, shorter than marginal setae. Reticulate elements longer

than wide except on posterior dorsum of hysterosoma where they are wider than long; reticulate elements do not meet dorsally on propodosoma. Reticulate elements of ventral plates wider than long; elements anterior to ventral plates about as wide as long; other ventral elements tend to be longer than wide. Posterior ventral hysterosomal setae of normal length, reaching slightly past suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II broadly lanceolate, serrate, about half as long as segment is wide. Length of body 233 μ; including rostrum 280 μ; width 146 μ.

Male.—Not known.

Deutonymph (Fig. 80).—Dorsal striations typical. Marginal setae 1, 5 lanceolate, serrate, somewhat smaller than 2; marginal setae 2, 3, 4, 6, 7, 8 and 9 larger, lanceolate, serrate, of about equal size. Marginal seta 5 lanceolate, serrate, minute. Dorsal hysterosomal setae short, apparently serrate.

Type host.—Privet.

Type locality.—Orlando, Florida.

Type.—U. S. National Museum No. 1823.

The type female, twenty-nine paratypes and twenty-two nymphs were collected on privet by M. A. Yothers (collection date not known). Other specimens were also collected on privet, Orlando, Florida, November 2, 1913 by M. A. Yothers.

Brevipalpus mcbridei, new species
Plate IX, Figs. 81-83

Female (Figs. 81, 82).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, reaching almost to middle of femur I; palpal segment II with a very slight inner basal swelling. Rostral shield with a pair of long median lobes and apparently only one pair of small lateral lobes; central portion of shield with longitudinal striae. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; all marginal setae short, lanceolate, serrate. Dorsal hysterosomal setae short, lanceolate and apparently serrate. Reticulate pattern of propodosoma not meeting dorsally, composed of a few lateral elements which are longer than wide; pattern on hysterosoma consists of a few striae forming a dorsal pattern whose elements are wider than long. Elements of reticulate pattern on ventral plates and area anterior to plates wider than long; other reticulate elements tend to be longer than wide. Posterior ventral hysterosomal setae of normal length, reaching to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II strong, reaching almost to tip of segment, lanceolate, serrate. Length of body 226 μ; including rostrum 280 μ; width 146 μ.

Male.—Not known.

Deutonymph (Fig. 83).—Dorsal striations typical. Marginal setae 1 and 4 small, of equal size, lanceolate serrate, about half as long as 2 and 3; setae 2, 3, 7, 8 and 9 large, lanceolate, serrate, of about equal size; seta 5 tiny, lan-

ceolate, serrate, about half as large as 6; seta 6 about half as large as 7 and slightly smaller than 4. Dorsal hysterosomal setae short, apparently serrate.

Type host.—English walnut.

Type locality.—Orlando, Florida.

Type.—U. S. National Museum No. 1824.

The type female, three paratypes and three nymphs were collected November 26, 1926 by O. C. McBride. Several hundred specimens were collected on citrus leaves at Orlando, Florida, July 14, 1948 by R. L. Miller. The nymphs showed some variation in setal pattern from those described from walnut in, at times, having setae 4, 5 and 6 small and of equal size. In a communication from Dr. Miller he states "this mite was from a nursery of Temple orange trees where it has been very abundant. The damage has been so severe enough on the leaves and some of the twigs so that the leaves have fallen off. The continued feeding of the mites causes a white corky layer to form on the surface of the leaf or green branch. A peculiar habit of this mite is that the eggs are deposited very abundantly around White Flies or Scale and the mites feed in these spots. This sometimes causes a yellow spot to develop that shows through on the top of the leaf. The mites are almost entirely on the under surface. It occurs on grapefruit and sour oranges in the same nursery."

Brevipalpus papayensis, new species

Plate X, Figs. 84-86

Tenuipalpus bioculatus McGregor, Jones, W. W. et al., 1941, Bul. Hawaii Agric. Exp. Sta. No. 87, p. 46 (misidentification).

Female (Figs. 84, 85).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, not reaching much past middle of femur I; palpal segment II with a sharp inner basal swelling. Rostral shield with a pair of long median lobes and a pair of small lateral lobes; shield with few central and posterior striae. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; marginal setae short, broadly lanceolate, serrate. Dorsal hysterosomal setae short, lanceolate and possibly serrate. Dorsal reticulate pattern varies from the normal in that on the propodosoma there are only a few longitudinal striae, not meeting dorsally; on the hysterosoma the striae form a reticulate pattern behind the posterior dorsal setae in which the elements are wider than long. Reticulate elements on ventral plates and area anterior to plates wider than long; laterad of plates elements longer than wide. Lateral areas of propodosoma with short longitudinal striae. Posterior ventral hysterosomal setae of normal length, reaching to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II short, lanceolate, serrate, about half as long as width of segment. Length of body 250 μ; including rostrum 270 μ; width 167 μ.

Male.—Not known.

Deutonymph (Fig. 86).—Dorsal striations typical. Marginal setae 1, 5

and 6 small, serrate; marginal setae 2, 3, 4, 7, 8 and 9 large, lanceolate, serrate. Dorsal hysterosomal setae small, simple.

Type host.—Papaya.

Type locality.—Kailua, Oahu, Hawaii.

Type.—U. S. National Museum No. 1825.

The type female, twenty-eight paratypes and fifteen nymphs were collected March 26, 1941 by W. C. Look. Six females and a nymph of what appears to be this species were collected on camphor leaf, U. S. Botanic Garden, Washington, D. C., March 15, 1924; a female collected on lemon fruit, Santiago de Las Vegas, Cuba, May 25, 1917 closely resembles the type specimens and may be this species.

BREVIPALPUS PSEUDOCUNEATUS (Blanchard)
Plate X, Figs. 87-89

Tenuipalpus pseudocuneatus Blanchard, (1939) 1940, Revista de la Facultad de Agronomia de la Plata (tercera época) XXIV: 11-14.

Female (Figs. 87, 88).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, not reaching much past middle of femur I; palpal segment II with a sharp inner basal swelling. Rostral shield with a pair of long median lobes and a pair of small, apparently bifurcate lateral lobes; central portion of shield with few striae. Propodosoma with three pairs of marginal setae; hysterosoma with six pairs of marginal setae; all marginal setae short, broadly lanceolate, serrate. Dorsal hysterosomal setae not as long as marginal setae; hysterosoma with six pairs of marginal setae; all marginal setae short, broadly lanceolate, serrate. Dorsal hysterosomal setae not as long as marginal setae, slightly lanceolate, apparently simple. On propodosoma reticulate pattern covers dorsum but is rather vague in center; laterally the reticulate elements are longer than wide. On hysterosoma lateral elements are longer than wide and central elements are much wider than long. Reticulate elements of ventral plates and area anterior to ventral plates wider than long. Other elements tend to be longer than wide. Posterior ventral hysterosomal setae almost reach to suture between propodosoma and hysterosoma. Tarsus setae almost reach to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II short, about half as long as width of segment, broadly lanceolate, serrate. Length of body 246 μ; including rostrum 294 μ; width 153 μ.

Male.—Not known.

Deutonymph (Fig. 89).—Dorsal striations typical. Marginal setae 1, 2, 5 and 6 small, serrate, of equal size. Marginal setae 3, 4, 7, 8 and 9 large, lanceolate, serrate, of about equal size, although 4 may be slightly smaller than others. Dorsal hysterosomal setae short, apparently simple.

Type host.—Citrus.

Type localities.—Provinces of Entre Rios, Corrientes and Santa Fé, Argentina.

The above re-descriptions were made from specimens collected on oranges

and lemons at Estacion Experimental Agricola, Tucuman, Province of Tucuman, Argentina, November 27, 1916 by E. W. Rust.

Brevipalpus longisetosus, new species

Plate X, Figs. 90-92

Female (Figs. 90, 91).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum short, not reaching past middle of femur I; palpal segment II with small inner basal swelling. Rostral shield with two long median lobes and two pairs of lateral lobes. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae lanceolate, serrate, those on propodosoma larger than those on hysterosoma. Dorsal hysterosomal setae lanceolate, serrate, about as long as marginal setae but narrower. Dorsal skin pattern composed of various longitudinal striations. Reticulate pattern on ventral plates and area directly anterior to plates composed of elements wider than long; other hysterosomal reticulate elements longer than wide. Reticulate pattern of coxae II with elements which are about as long as wide; laterad of coxae II the reticulate elements are longer than wide. Posterior ventral hysterosomal setae reaching to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II broadly lanceolate, serrate, about half as long as width of segment. Length of body 213 μ; including rostrum 247 μ; width 140 μ.

Male.—Not known.

Deutonymph (Fig. 92).—Dorsal striations typical of the genus. Marginal setae 1, 4, 5, 6, 7 and 9 simple and quite minute; setae 2, 3 and 8 very long, whiplike; seta 10 large, lanceolate, serrate.

Type host.—"Undetermined plant."

Type locality.—Yauco, Puerto Rico.

Type.—U. S. National Museum No. 1826.

The type female, five paratypes and seven nymphs were collected November 23, 1935 by L. C. Fife.

BREVIPALPUS CALIFORNICUS (Banks)

Plate XI, Figs. 93-95

Tenuipalpus californicus Banks, 1904, Jour. N. Y. Ent. Soc. 12: 55, pl. 2, fig. 2.
Tenuipalpus californicus Banks, 1907, Proc. U. S. N. Mus. 32: 599.
Brevipalpus californicus (Banks), McGregor, 1949, Mem. South. Calif. Acad. Sci. III (2): 11-13, text fig. 3, pl. I.

Female (Figs. 93, 94).—Body broadest at or just anterior to suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, extending to middle of femur I; palpal segment II with inner basal swelling. Rostral shield with two long median lobes and two pairs of short lateral lobes as figured. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all

marginal setae short, lanceolate, serrate. Dorsal hysterosomal setae appear simple, about as long as marginal setae. Reticulate pattern on propodosoma with lateral elements slightly longer than wide, reticulation not meeting dorsally, but with few irregular lines as figured; hysterosoma with same pattern. Reticulate pattern of both ventral plates and area anterior to plates with elements which are wider than long; other ventral reticulate elements longer than wide. Coxae I and II with few transverse striations. Posterior ventral hysterosomal setae almost reaches suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae on femora I and II lanceolate, serrate, about half as long as segment is wide, that on femur I appears to be slightly longer and wider than on femur II. Length of body 240 μ; including rostrum 287 μ; width 156 μ.

Male.—Not known.

Deutonymph (Fig. 95).—Dorsal striations typical, as figured. Marginal setae subequal; setae 7 to 10 largest, lanceolate, serrate, of equal size; setae 1, 2, 4, 5 and 6 small, short, lanceolate, serrate; seta 3 about twice as large as 1, lanceolate, serrate.

Type host.—Orange peel.

Type locality.—Redlands, California.

Type.—U. S. National Museum No. 1827.

Redescribed from type material in the U. S. National Museum. Also examined were specimens collected on lemons, Corona, California, August 7, 1914, by ..... Foster; on orange, Redlands, California, August 15, 1903 by A. S. Pearse; on lemon fruits, East Redlands, California, January 5, 1944 by H. Lewis and E. A. McGregor; in lemon bud, Santa Paula, California, December 10, 1938 by W. E. Buckner. Specimens appearing to be this species were collected by R. P. Wilbur July 11, 1935 at Nogales, Arizona, on geraniums originating in Mexico.

BREVIPALPUS WOGLUMI McGregor

Plate XI, Figs. 96-98

Brevipalpus woglumi McGregor, 1949, Mem. So. Calif. Sci. 3 (2): 19-21, text. fig. 7, Pl. V.

Female (Figs. 96, 97).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal length, extending slightly past middle of femur I; palpal segment II with a slight inner basal swelling. Rostral shield with a pair of long median lobes and a pair of small lateral lobes; posterior and central portion of shield with few markings. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae short, slightly lanceolate, serrate. Dorsal hysterosomal setae short, slightly lanceolate, probably serrate. Reticulate pattern covers dorsum of mite, reticulate elements of propodosoma longer than wide, not definite in center; lateral elements on hysterosoma longer than wide; dorsal elements wider than long. Reticulate elements of ventral plates and area anterior to plates wider than

long; rest of ventral elements tend to be longer than wide. Posterior ventral hysterosomal setae of normal length, reaching to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II lanceolate, serrate, about half as long as segment is wide. Length of body 233 μ; including rostrum 273 μ; width 140 μ.

Male.—Not known.

Deutonymph (Fig. 98).—Dorsal striations appear typical. Marginal setae 3, 4, 7, 8, 9 and 10 large, broadly lanceolate, serrate, of about equal size. Marginal setae 1 and 2 serrate, short; setae 5 and 6 serrate, smaller than 1 and 2. Dorsal hysterosomal setae short.

Type host.—Lemons.

Type locality.—West Hillsdale, Spring Valley, San Diego, California.

Type.—U. S. National Museum No. 1528.

Nine females and four nymphs, designated as type material, were collected October 27, 1944 by R. S. Woglum.

BREVIPALPUS AUSTRALIS (Tucker)

Plate XI, Figs. 99-103

Tenuipalpus obovatus of authors, *nec* Donnadieu (on tea in Ceylon).
Tenuipalpus australis Tucker, 1926, Union So. Africa Dept. Agr. Div. Ent. Mem. 5: 3, 4, pls. I, II.
Tenuipalpus vitis Womersley, 1940, Trans. Roy. Soc. South Austral. 64 (2): 241, 242, fig. 3; 1941, 65 (1): 42 (treated as synonym of *australis*).
Tenuipalpus australis Tucker, Womersley, 1941, Trans. Roy. Soc. South Austral. 65 (1): 42.
Tenuipalpus phoenicis Geijskes, Womersley, 1940. Ibid., 64 (2): 234.
Tenuipalpus californicus Banks, Womersley, 1940. Ibid., 64 (2): 239.
Tenuipalpus californicus Banks, Womersley, 1941. Ibid., 65 (1): 42, fig. c.
Tenuipalpus australis Tucker, Lawrence, 1943, Trans. Roy. Soc. South Africa, XXX (1): 39, 40.

Female (Figs. 99, 100, 102, 103).—Body broadest at propodosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, not reaching past middle of femur I; palpal segment II without inner basal swelling. Rostral shield with two long inner lobes and two pairs of small lateral lobes which may or may not vary as figured. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae short, slightly lanceolate with few serrations. The three pairs of dorsal hysterosomal setae short, of equal size. Propodosoma covered with a reticulate pattern in which the elements are about as long as wide; hysterosoma covered with a reticulate pattern in which the marginal elements are longer than wide, while in the region between the dorsal setae the pattern is quite irregular, not forming complete cells as elsewhere. Reticulate pattern of ventral plates consists of elements which are wider than long. Reticulate elements anterior to ventral plate wider than long. Elsewhere ventral reticulate elements tend to be longer than wide. Coxae I and II with transverse striae. Posterior ventral hysterosomal setae reaching to suture between propodosoma and hysterosoma. Tarsus II with two short rodlike sensory setae (fig. 102). Dorsal setae of femora I and II short, lanceolate, serrate, about half as long as seg-

ment is wide. Length of body 240 μ; including rostrum 286 μ; width 147 μ.

Male.—Not known.

Deutonymph (Fig. 101).—Dorsal skin pattern of normal striations as figured. Marginal setae 2, 3, 4, 7, 8, 9 and 10 of medium size, lanceolate, serrate, of approximately equal size; setae 1, 5 and 6 not half as large as others, lanceolate, serrate, of approximately equal size; dorsal hysterosomal setae short, apparently simple.

Type host.—Citrus fruits.

Type locality.—South Africa and Southern Rhodesia.

The above redescription was made from two females and a nymph collected on oranges at Womberal, N. S. W., Australia, April 20 and 30, 1931 by "T. MC.". Also examined and determined to be this species are specimens collected on orange, South Africa, October 28, 1926, by J. C. Faure; on grapefruit originating in Algeria and intercepted at Baltimore, Maryland, March 16, 1943 by L. L. Spessard; on gardenia leaf originating in Mexico and intercepted at Brownsville, Texas, December 14, 1945, by R. E. Burnett.

Specimens of *Brevipalpus* from tea in Ceylon sent in by C. D. Gadd who stated that they were the mites which were known as *Tenuipalpus obovatus* Donnadieu in that area appear to be *B. australis* (Tucker). The adult females appear to be identical; the protonymphs are similar although there is a tendency for seta 1 to be larger in the tea form; no deutonymphs of the citrus form were available for study but in those from tea seta 1 is much larger than setae 5 and 6 but still smaller than 2.

Brevipalpus confusus, new species
Plate XII, Figs. 104-108

Female (Figs. 104, 105).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma margins converging to broadly rounded rear. Rostrum of normal size, not reaching past middle of femur I; palpal segment II without inner basal swelling. Rostral shield with three pairs of lobes, the inner pair only slightly longer than the others. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae, short, slightly lanceolate, with few serrations. The three pairs of dorsal hysterosomal setae short, of equal size, slightly lanceolate. Propodosoma covered with a reticulate pattern in which the elements tend to be slightly longer than wide; hysterosoma covered with a reticulate pattern in which the elements tend to be longer than wide. Reticulate elements of ventral plates wider than long; elements anterior to ventral plate wider than long; other elements tend to be longer than wide or of about equal dimensions. Coxae I and II with few transverse striae. Posterior ventral hysterosomal setae almost reach suture between propodosoma and hysterosoma. Tarsus II with two short rodlike sensory setae. Dorsal setae of femora I and II lanceolate, serrate, about half as long as width of segment. Length of body 253 μ; including rostrum 280 μ; width 153 μ.

Male (Figs. 107, 108).—Broadest at propodosoma; hysterosomal margins converging to rear, not, or only slightly constricted at hysterosomal suture. Rostrum reaching to middle of femur I; palpal segment II without inner basal swelling. Rostral shield with three pairs of lobes, the inner pair slightly longer than the other two. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae lanceolate, serrate; dorsal hysterosoma setae short, slightly lanceolate. Dorsal reticulate pattern covering propodosoma and hysterosoma; reticulate elements on propodosoma and anterior portion of hysterosoma as a whole about as long as wide while those on posterior portion of hysterosoma longer than wide. Reticulate pattern on posterior venter of mite with elements about as long as wide; elements behind posterior ventral hysterosoma setae wider than long; other elements tend to be longer than wide. Dorsal setae of femora I and II lanceolate, serrate, about as long as width of segment. Length of body 233 μ; including rostrum 286 μ; width 140 μ.

Deutonymph (Fig. 106).—Dorsal skin pattern normal, as figured. Marginal setae 3, 4, 7, 8, 9 and 10 large of equal size, lanceolate, serrate; setae 1 and 2 short, lanceolate, serrate; setae 5 and 6 smaller than 1 and 2 and lanceolate; dorsal hysterosomal setae similar to marginal setae 5 and 6.

Type host.—Orchids.

Type locality.—College Park, Maryland.

Type.—U. S. National Museum No. 1828.

Described from the type female, seventy-nine paratype females, two males and four nymphs collected on orchids, University of Maryland Greenhouse, College Park, Maryland by E. Haviland March 28, 1947.

Brevipalpus trinidadensis, new species
Plate XII, Figs. 109-111

Female (Figs. 109, 110).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum of normal size, not reaching past middle of femur I; palpal segment II with slight inner basal swelling. Rostral shield simple, with a pair of long median lobes and a pair of small lateral lobes; shield sculptured on posterior portion. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae short, slightly lanceolate and appear to be without serrations. Dorsal hysterosomal setae short, simple. Reticulate pattern covers entire dorsum of propodosoma; reticulate elements perhaps slightly longer than wide. Elements of reticulate pattern on hysterosoma longer than wide except on posterior dorsal portion where they are wider than long. Reticulate elements of ventral plates wider than long; reticulate elements just anterior to plates slightly wider than long; other ventral reticulate elements longer than wide. Posterior ventral hysterosomal setae of normal length, reaching to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae of femora I and II lanceolate, serrate, about half as long as the width of the segment. Length of body 213

μ; including rostrum 267 μ; width 133 μ.

Male.—Not known.

Deutonymph (Fig. 111).—Dorsal striate pattern typical. Marginal setae 1, 2, 3, 4, 8 and 10 lanceolate, serrate, 1 only slightly so and smaller than others; 2, 3, and 4 slightly larger than 1 but about half the size of 8 and 10; marginal setae 5, 6 and 7 and dorsal hysterosomal setae short, simple and of about same size. This is probably a protonymph rather than a deutonymph.

Type host.—Lantana.

Type locality.—St. Augustine, Trinidad.

Type.—U. S. National Museum No. 1829.

The type female, two paratypes and one nymph were collected May 28, 1937 by R. G. Fennah.

BREVIPALPUS GREWIAE (Rübsaamen)
Plate XII, Fig. 112

Pediculoides grewiae Rübsaamen, 1899, Ent. Nachr. 25 (16): 255-257, figs. 2, 3.
Tenuipalpus grewiae (Rübsaamen), Oudemans, 1938, Tijds. v. Ent. 81, Verslag LXXIII, LXXIX.

The form described is that of a male.

Type host.—*Grewia microcus* L., in galls.

Type locality.—India.

Brevipalpus browningi, new species
Plate XIII, Figs. 113-116

Tenuipalpus obovatus Donnadieu, Sayed, 1942, Bull. Soc. Fouad Ier Ent. XXVI: 97, 98, pls. VI, VII; 1946, idem. XXX: 103, (misidentification).

Female (Figs. 113-114).—Body broadest at suture between propodosoma and hysterosoma; hysterosoma with lateral margins converging posteriorly. Rostrum not reaching past middle of femur I; palpal segment II with a small inner basal swelling. Rostral shield with two long median lobes and two pairs of small lateral lobes. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; marginal setae small, lanceolate, serrate. Dorsal hysterosomal setae small, about as long as marginal setae. Reticulate pattern covers dorsal surface of body; on propodosoma the reticulate elements are, in general, slightly longer than wide; on the hysterosoma the lateral elements are longer than wide and dorsally they lengthen considerably. Posterior ventral plate reticulate elements much wider than long; anterior plate and area anterior to it with elements slightly wider than long; coxae I and II with a few transverse striae; reticulate elements laterad of coxae II and laterad of ventral plates slightly longer than wide. Posterior ventral hysterosomal setae reach to suture between propodosoma and hysterosoma. Tarsus II with two rodlike sensory setae. Dorsal setae on femora I and II lanceolate, serrate, about half as long as width of segment. Length of body 246 μ; including rostrum 286 μ; width 148 μ.

Male (Fig. 116).—Not seen, figure from Sayed 1942.

Deutonymph (Fig. 115).—Dorsal skin striations typical. Marginal setae 1, 3, 4, 7, 8, 9 and 10 long, lanceolate, serrate, of about equal size; seta 2 slightly shorter than 1 and 3; setae 5 and 6 about a third shorter than 7 to 10, 6 being slightly shorter than 5. Anterior pair of dorsal hysterosomal setae appears larger than others, slightly serrate; other two pairs appear to be simple.

Type host.—Citrus.

Type locality.—Gaza, Palestine.

Type.—British Museum; seven paratypes in the British Museum and four paratypes in the U. S. National Museum. (U. S. National Museum No. 1830). The type female and eleven paratypes collected on citrus branches and leaves, Beit-Hanum (Gaza), Palestine, April 2, 1946 by P. Jolles and were received for study from E. Browning of the British Museum. Males, females and nymphs collected in Egypt on Citrus, guava, plums and apricots were kindly sent to the U. S. National Museum by Dr. Taher Sayed; a single nymph was collected on grapefruit, originating in Palestine, at New York by R. W. Woodbury, January 5, 1936.

Brevipalpus pini, new species

Plate XIII, Figs. 117-119

Female.—Not known.

Male (Figs. 117, 118).—Body broadest at propodosoma; constricted at hysterosomal suture behind coxae IV. Rostrum of normal size, extending to middle or only slightly beyond middle of femur I; palpal segment II broad, narrowing basally. Rostral shield short, median lobes no longer than lateral lobes; the shape of the lobes is variable but is more or less as figured. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs; all marginal setae of medium length, lanceolate, serrate. Dorsal hysterosomal setae serrate, the anterior and posterior pairs longer than the middle pair. Dorsal reticulate pattern as figured, not meeting dorsally, elements longer than wide on propodosoma and posterior portion of hysterosoma, variable on anterior portion of hysterosoma. Venter of mite with only a few striae as figured. Dorsal setae of femora I and II lanceolate, serrate, about half as long as the width of the segment. Length of body about 246 μ; including rostrum and genital apparatus 307 μ; width 150 μ.

Deutonymph (Fig. 119).—Dorsal striations typical. Marginal setae short, small, of about equal length; all setae except seta 6 lanceolate, serrate; seta 6 lanceolate, smooth. Anterior pair of dorsal hysterosomal setae about as long as marginal setae, lanceolate, serrate; the two posterior pairs of setae appear to be slightly lanceolate and smooth as in marginal seta 6.

Type host.—Monterey Pine.

Type habitat.—Glendale, California.

Type.—U. S. National Museum No. 1831.

The male type, one male paratype and a nymph were collected by V. E. Williams in April, 1932.

BREVIPALPUS NATALENSIS (Lawrence)
Plate XIV, Figs. 120, 121

Tenuipalpus natalensis Lawrence, 1943, Trans. Royal Soc. South Africa XXX (1): 45-47, fig. 6.

Lawrence figures only the male. The dorsal reticulations are not shown but he states: "The body, especially in its anterior two-thirds, entirely covered with a network sculpture consisting of small, more or less quadriform segments; this sculpture absent on the narrow transverse band in the region of the constriction posterior to leg IV."

Type host.—*Halleria lucida* L.

Type locality.—Karkloof, near Pietermaritzburg, South Africa.

BREVIPALPUS SALVIAE McGregor
Plate XIV, Figs. 122-124

Brevipalpus salviae McGregor, 1949, Mem. So. Calif. Sci. 3 (2): 21-23, Pl. VI.

Female.—The only female available for study was one within the last nymphal skin, and the characters of the venter were indistinct. The following characters could be seen. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all marginal setae long, large, serrate. Dorsal hysterosomal setae large, serrate, probably not as long as marginal setae. Entire dorsum covered with a reticulate pattern whose elements tend to be longer than wide. Tarsus II with one rodlike sensory seta.

Male (Figs. 122, 123).—Body not constricted at hysterosomal suture. Rostrum long, extending past tip of femur I. Rostral shield with a pair of long median lobes and a pair of short lateral lobes; central portion of shield striate and posterior portion reticulate. Propodosoma with three pairs of marginal setae; hysterosoma with seven pairs of marginal setae; all but posterior pair of setae quite long, serrate. Dorsal hysterosomal setae as long as marginal setae, serrate. Reticulate pattern covers most of dorsum of mite; elements on propodosoma tend to be slightly longer than wide; those on anterior portion of hysterosoma wider than long; those on posterior portion of hysterosoma much longer than wide. Posterior venter of hysterosoma covered with reticulate pattern in which the elements are longer than wide. Rest of venter apparently without striae or reticulate pattern. Dorsal setae of femora I and II longer than segment is wide, strongly serrate. Length of body 190μ; including rostrum 267 μ; width 120 μ.

Deutonymph (Fig. 124).—Dorsal skin pattern not seen since this description is based on a specimen within which the adult female has formed. All marginal setae strongly serrate, quite long, 9 and 10 not as long as others. Dorsal hysterosomal setae as long as marginal setae, serrate.

Type host.—Salvia sp.

Type locality.—Santa Paula, California.

Type.—U. S. National Museum No. 1529.

The above redescription is based on type material collected July 27, 1937 by "Citrus Experiment Station workers."

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EXPLANATION OF PLATES

PLATE *I.—Brevipalpus edwinae*, new species, Figs. 1-5.—1, dorsal view of female; 2, ventral view of female; 3, dorsal view of male; 4, ventral view of male; 5, tarsus II of female.

Brevipalpus mcgregori, new species, Figs. 6-8.—6, dorsal view of female; 7, ventral view of female; 8, dorsal view of nymph.

Brevipalpus chilensis, new species, Figs. 9-10.—9, dorsal view of female; 10, ventral view of female.

PLATE II.—*Brevipalpus inornatus* (Banks), Figs. 11-15.—11, dorsal view of female; 12, ventral view of female; 13, dorsal view of male; 14, ventral view of male; 15, dorsal view of nymph.

Brevipalpus phoenicis (Geijskes) (after Geijskes 1939), Figs. 16-17.—16, ventral view of female; 17, dorsal view of female.

Brevipalpus pereger Donnadieu (after Donnadieu 1875), Figs. 18-19.—18, leg. I; 19, setae.

Brevipalpus pulcher (Canestrini & Fanzago) (after Canestrini 1890), Fig. 20.—ventral view of male.

PLATE III.—*Brevipalpus oleae,* new species, Figs. 21-23.—21, dorsal view of female; 22, ventral view of female; 23, dorsal view of nymph.

Brevipalpus oncidii, new species, Figs. 24-30.—24, dorsal view of female; 25, ventral view of female; 26, ventral view of male; 27, dorsal view of male; 28, dorsal view of nymph; 29, marginal seta, female; 30, marginal setae, male.

PLATE IV.—*Brevipalpus garmani,* new species, Figs. 31-35.—31, dorsal view of female; 32, ventral view of female; 33, ventral view of male; 34, dorsal view of male; 35, dorsal view of nymph.

Brevipalpus cuneatus (Canestrini & Fanzago), Figs. 36-37.—36, dorsal view of female; 37, ventral view of female.

Brevipalpus lewisi McGregor, Figs. 38-39.—38, dorsal view of female; 39, ventral view of female.

PLATE V.—*Brevipalpus lewisi* McGregor, Fig. 40.—dorsal view of nymph.

Brevipalpus cardinalis (Banks), Figs. 41-45.—41, dorsal view of female; 42, ventral view of female; 43, dorsal view of nymph; 44, dorsal view of male; 45, ventral view of male.

Brevipalpus essigi, new species, Figs. 46-48.—46, dorsal view of female; 47, ventral view of female; 48, dorsal view of nymph.

PLATE VI.—*Brevipalpus sayedi,* new species, Figs. 49-50.—49, dorsal view of female; 50, ventral view of female.

Brevipalpus russulus (Boisduval), Figs. 51-55.—51, dorsal view of female; 52, ventral view of female; 53, dorsal view of male; 54, ventral view of male; 55, dorsal view of nymph.

Brevipalpus lilium, new species, Figs. 56-57.—56, ventral view of female; 57, dorsal view of female.

PLATE VII.—*Brevipalpus lilium,* new species, Figs. 58-60.—58, dorsal view of male; 59, ventral view of male; 60, dorsal view of nymph.

Brevipalpus oudemansi (Geijskes) (after Geijskes 1939), Figs. 61-62.—61, dorsal view of female; 62, ventral view of female.

Brevipalpus pyri Sayed, Figs. 63-66.—63, dorsal view of female; 64, ventral view of female; 65, dorsal view of male (after Sayed 1942); 66, dorsal view of nymph, some setae missing.

PLATE VIII.—*Brevipalpus pyri* Sayed, Fig. 67.—ventral view of male (after Sayed 1942).

Brevipalpus donnadieui (Oudemans), Figs. 68-70.—68, genital plate region, female (after Canestrini 1890); 69, ventral view of female (after Donnadieu 1875); 70, dorsal view of female (after Donnadieu 1875).

Brevipalpus geisenheyeri (Rübsaamen) (after Rübsaamen 1910), Figs. 71-72.—71, dorsal view of female; 72, ventral view of female.

Brevipalpus obovatus Donnadieu (after Donnadieu 1875), Figs. 73-75.—73, dorsal view of male; 74, dorsal view of male; 75, larva.

PLATE IX.—*Brevipalpus spinosus* (Donnadieu) (after Donnadieu 1875), Figs. 76-77. —76, view showing setae and some internal organs; 77, dorsal view of female.

Brevipalpus yothersi, new species, Figs. 78-80.—78, dorsal view of female; 79, ventral view of female; 80, dorsal view of nymph.

Brevipalpus mcbridei, new species, Figs. 81-83.—81, dorsal view of female; 82, ventral view of female; 83, dorsal view of nymph.

PLATE X.—*Brevipalpus papayensis,* new species, Figs. 84-86.—84, dorsal view of female; 85, ventral view of female; 86, dorsal view of nymph.

Brevipalpus pseudocuneatus (Blanchard), Figs. 87-89.—87, dorsal view of female; 88, ventral view of female; 89, dorsal view of nymph.

Brevipalpus longisetosus, new species, Figs. 90-92.—90, dorsal view of female; 91, ventral view of female; 92, dorsal view of nymph.

PLATE XI.—*Brevipalpus californicus* (Banks), Figs. 93-95.—93, dorsal view of female; 94, ventral view of female; 95, dorsal view of nymph.

Brevipalpus woglumi McGregor, Figs. 96-98.—96, dorsal view of female; 97, ventral view of female; 98, dorsal view of nymph.

Brevipalpus australis (Tucker), Figs. 99-103.—99, dorsal view of female; 100, ventral view of female; 101, dorsal view of nymph; 102, Tarsus II of female; 103, tarsal claw.

PLATE XII.—*Brevipalpus confusus,* new species, Figs. 104-108.—104, dorsal view of female; 105, ventral view of female; 106, dorsal view of nymph; 107, dorsal view of male; 108, ventral view of male.

Brevipalpus trinidadensis, new species, Figs. 109-111.—109, dorsal view of female; 110, ventral view of female; 111, dorsal view of nymph.

Brevipalpus grewiae (Rübsaamen) (after Rübsaamen 1899), Fig. 112.—dorsal view of male.

PLATE XIII.—*Brevipalpus browningi,* new species, Figs. 113-116.—113, dorsal view of female; 114, ventral view of female; 115, dorsal view of nymph; 116, ventral view of male (after Sayed 1942).

Brevipalpus pini, new species, Figs. 117-119.—117, ventral view of male; 118, dorsal view of male; 119, dorsal view of nymph.

PLATE XIV.—*Brevipalpus natalensis* (Lawrence) (after Lawrence 1943), Figs. 120-121.—120, dorsal view of male; 121, ventral view of male.

Brevipalpus salviae McGregor, Figs. 122-124.—122, dorsal view of male; 123, ventral view of male; 124, dorsal view of nymph.

Brevipalpus linki, new species, Figs. 125-127.—125, dorsal view of female; 126, ventral view of female; 127, dorsal view of nymph.

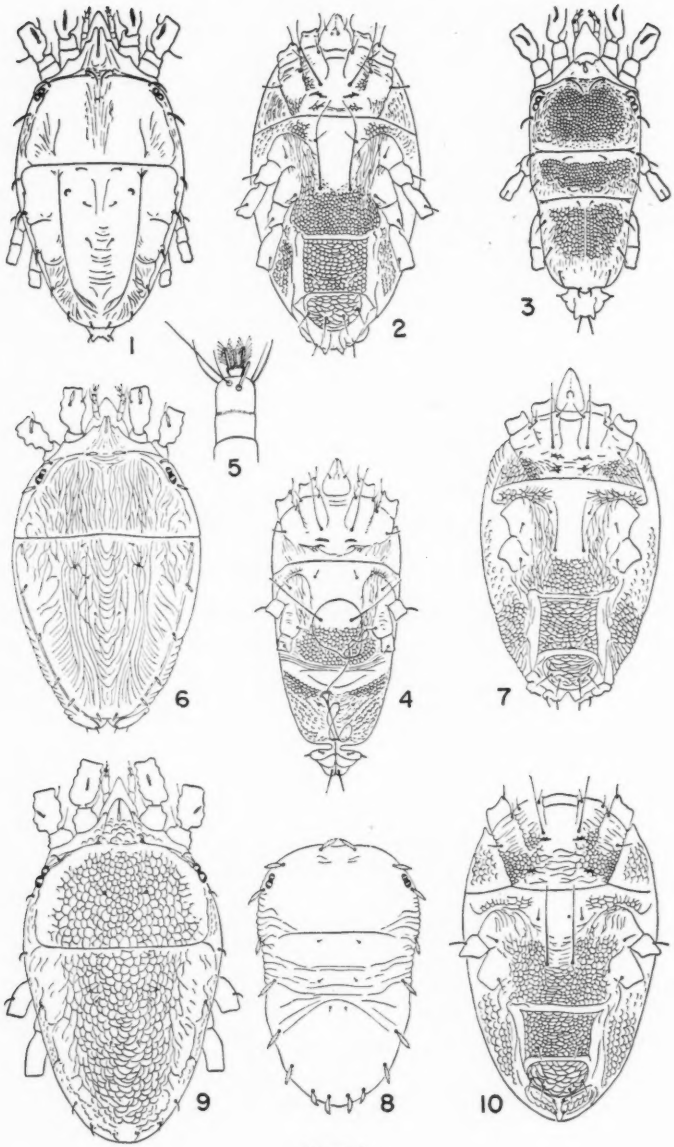
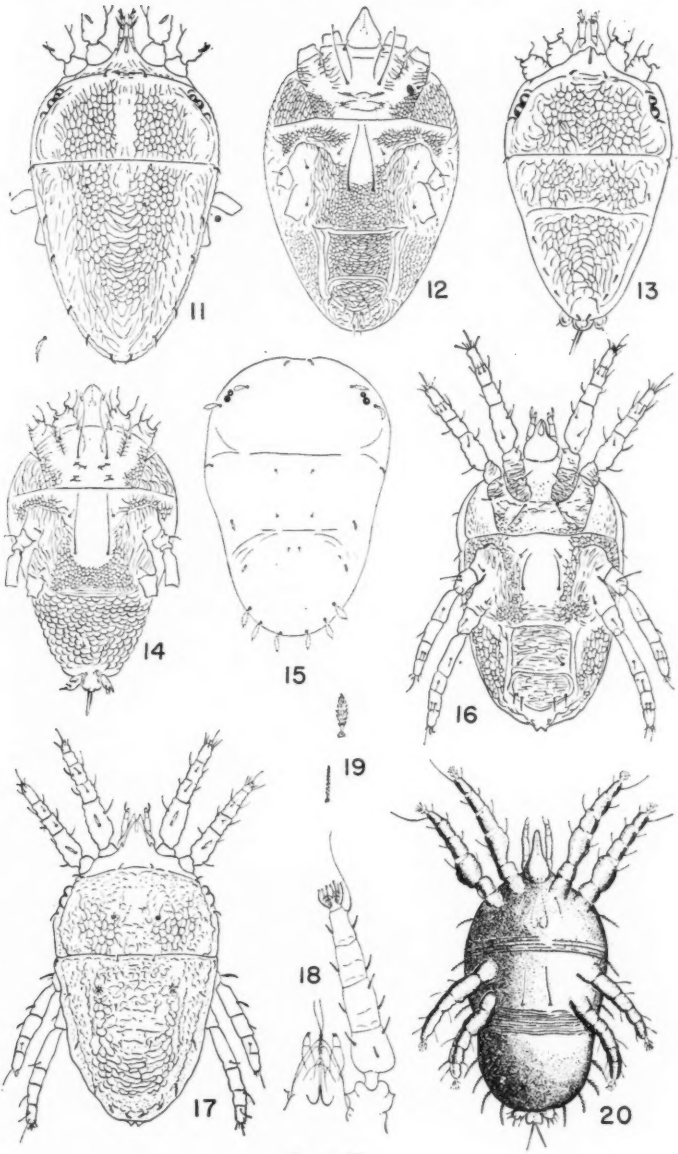


PLATE I



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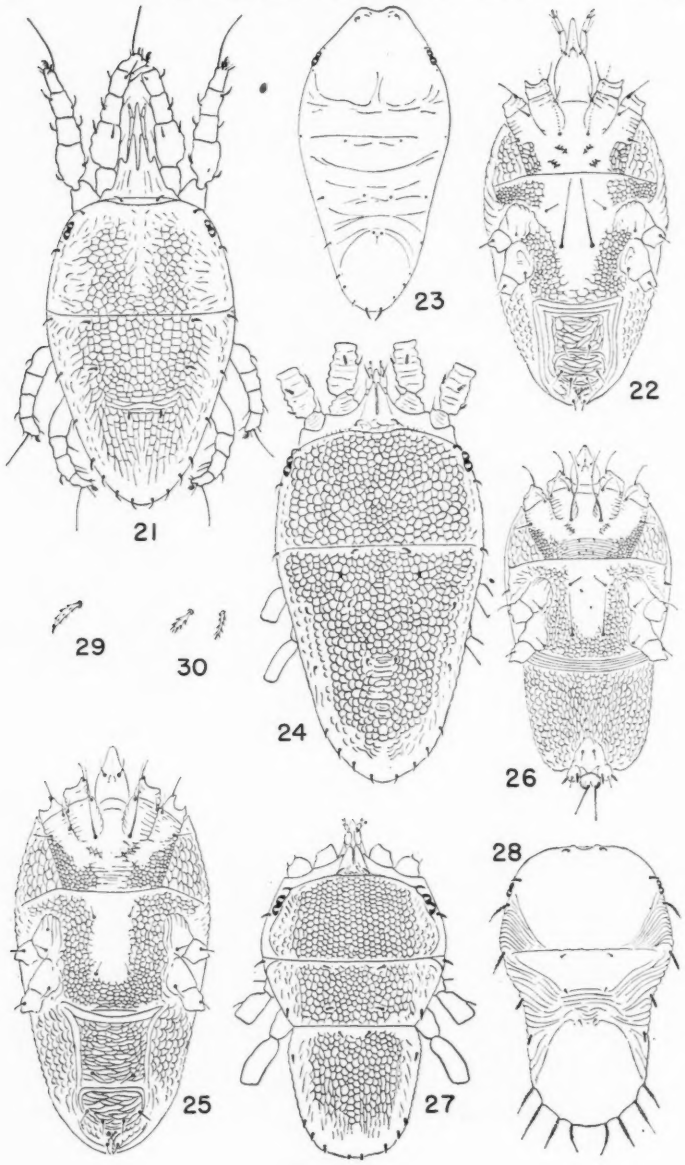

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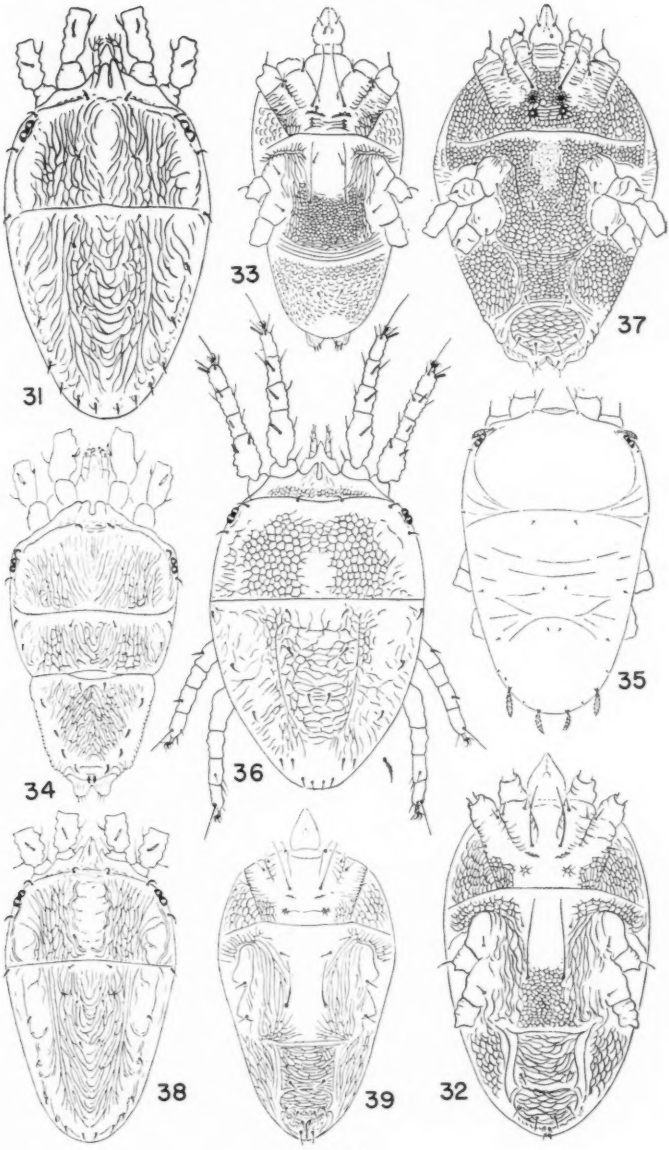

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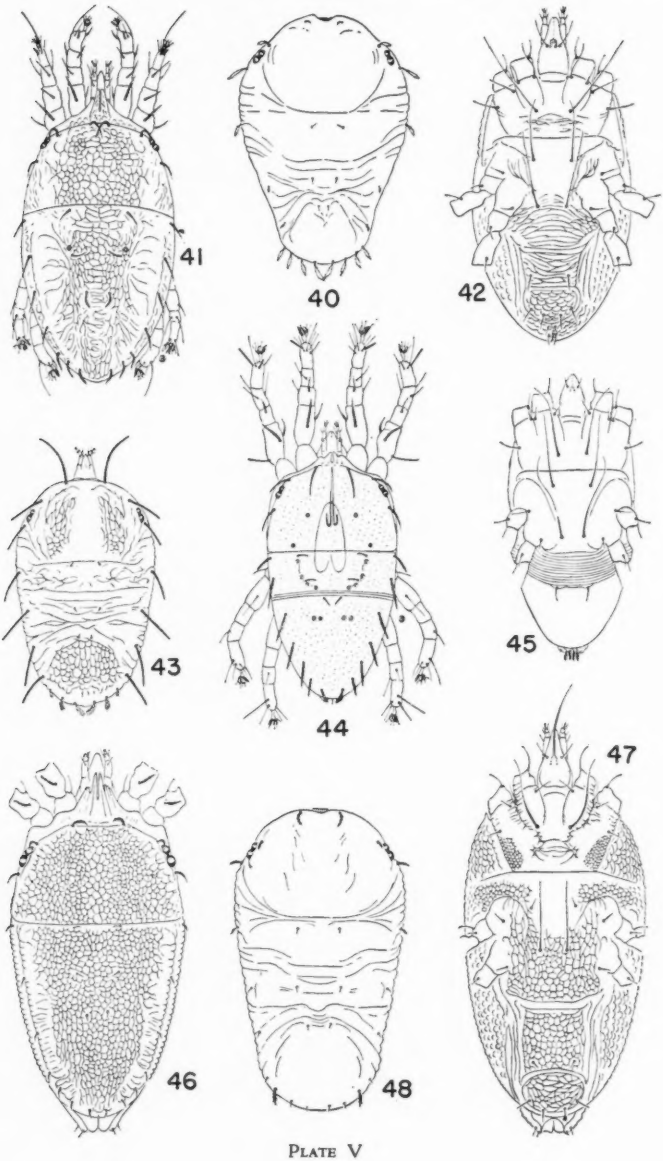

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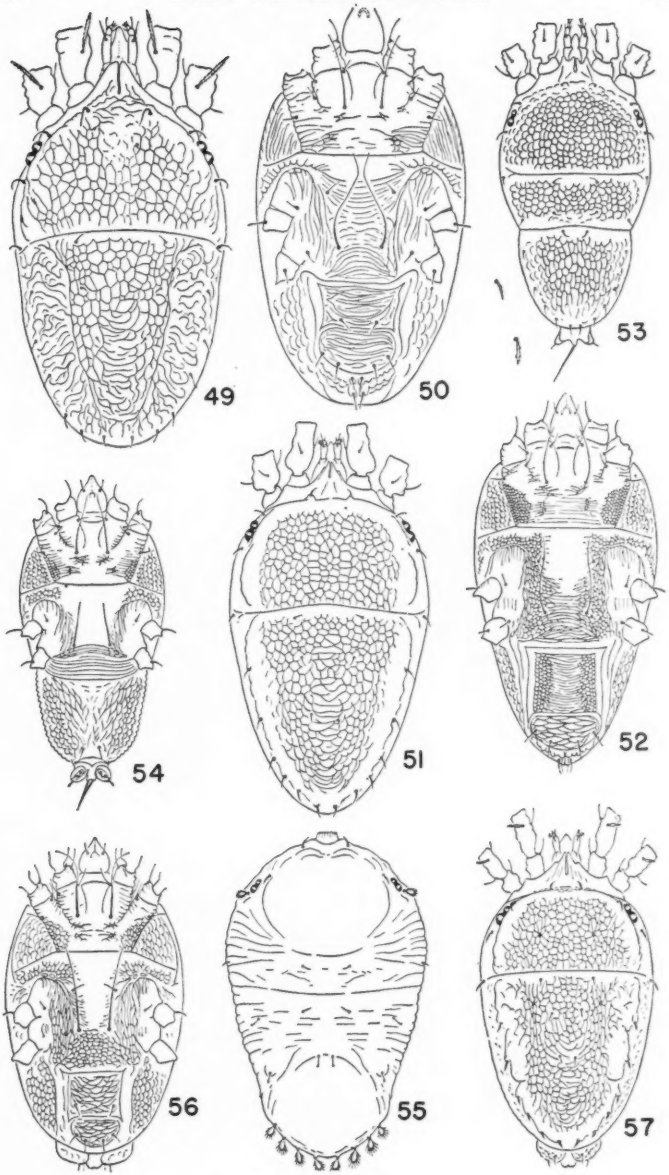

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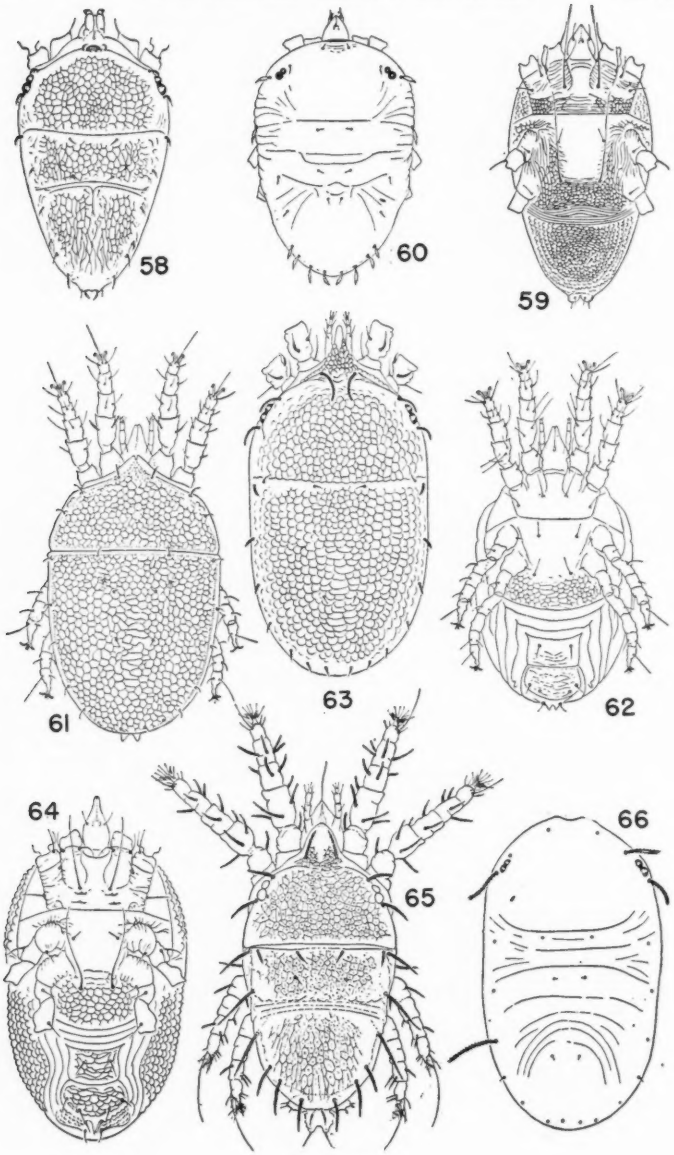

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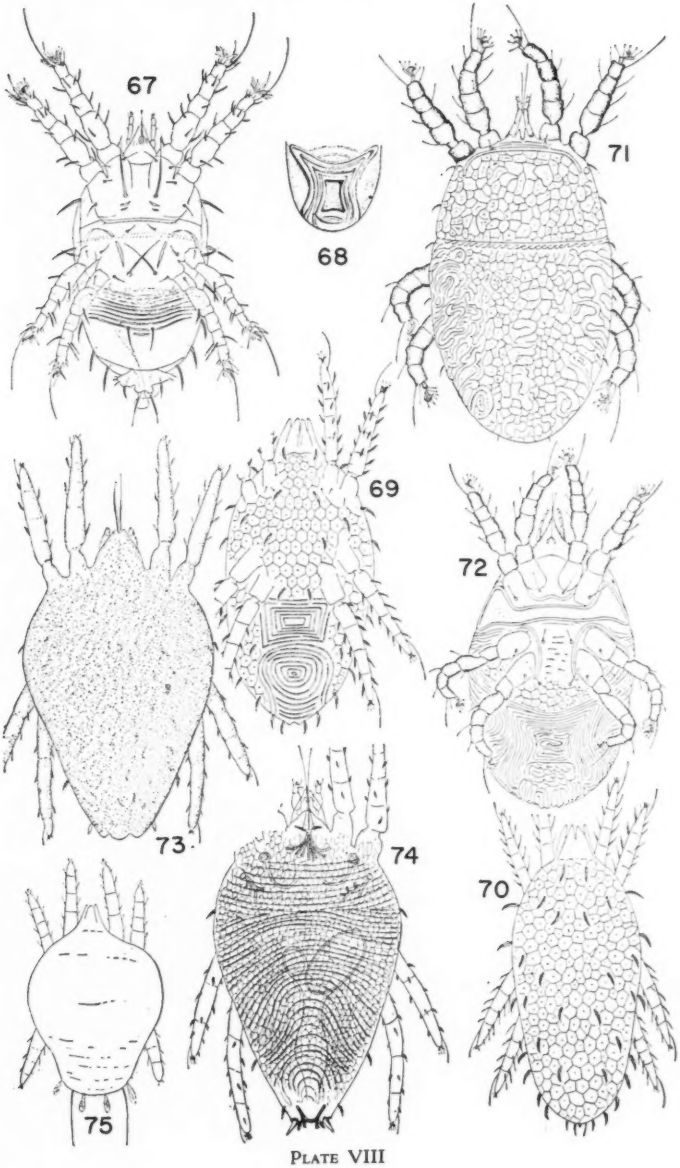

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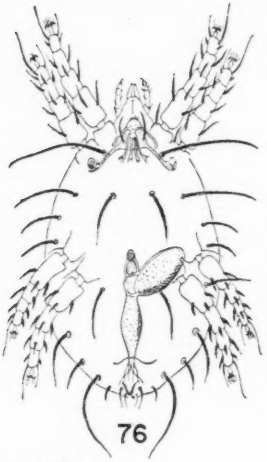

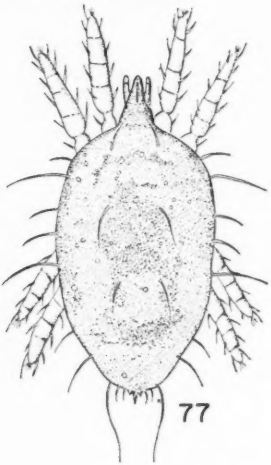

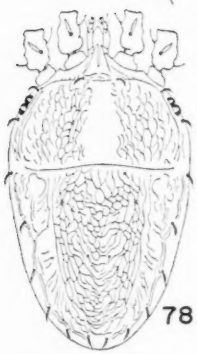

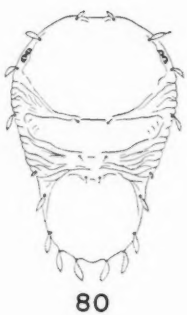

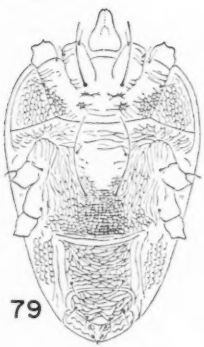

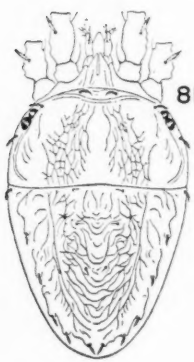

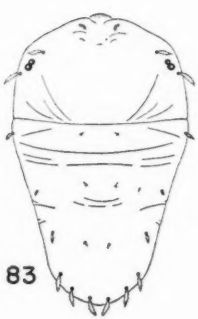

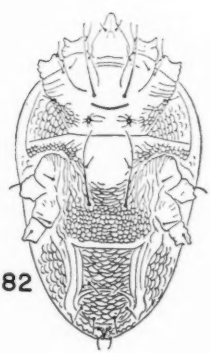

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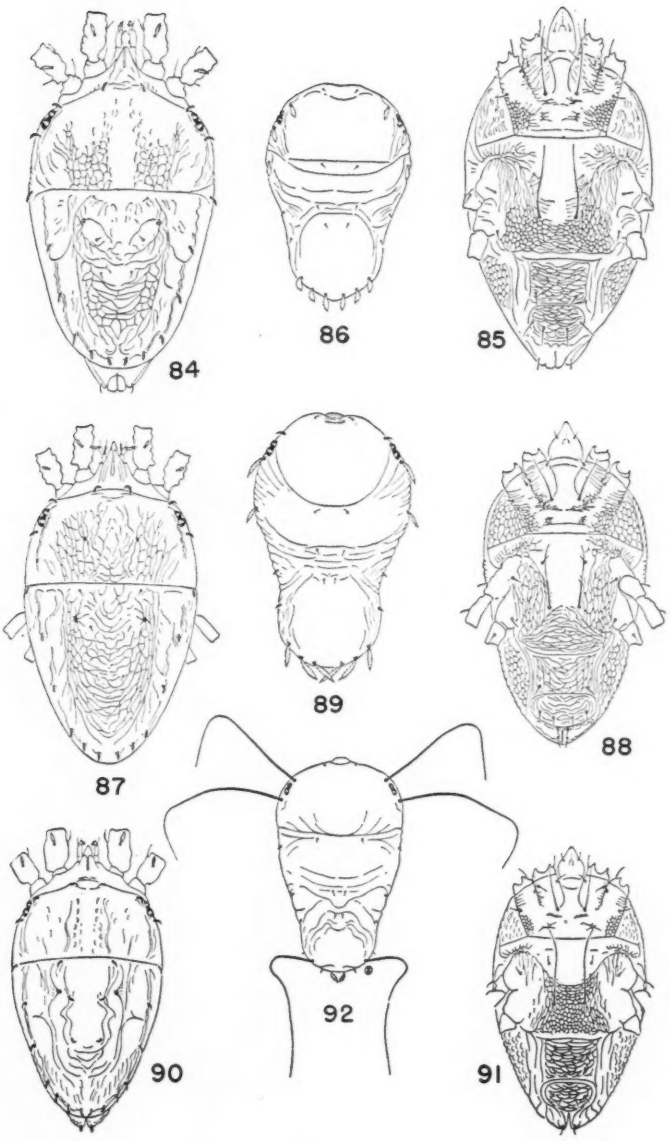

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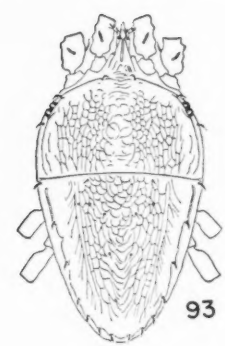
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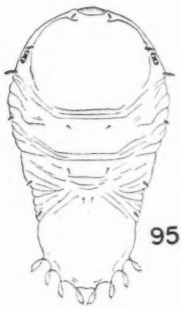
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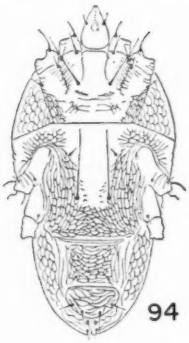
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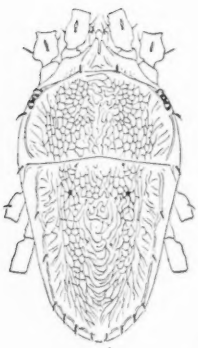
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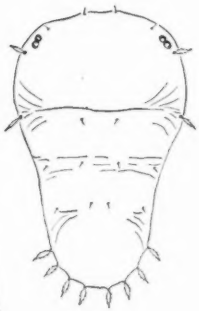
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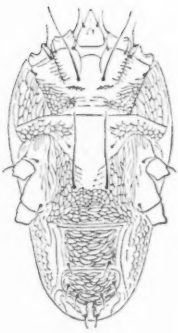
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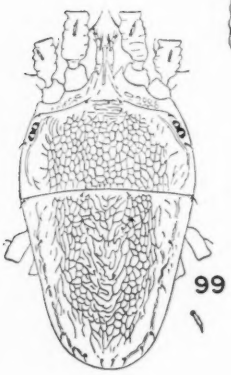
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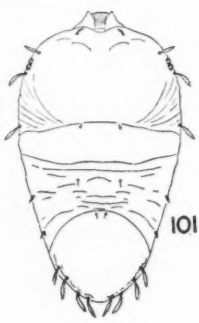
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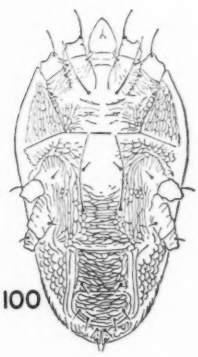
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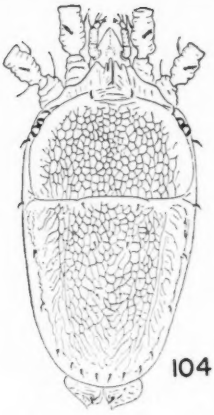
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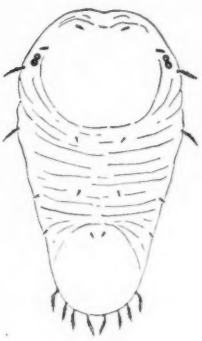
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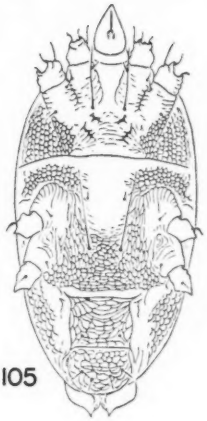
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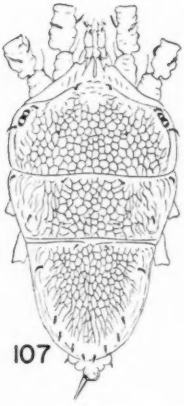
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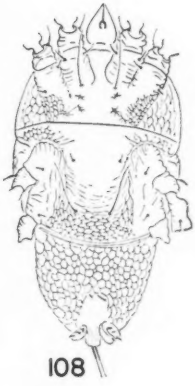
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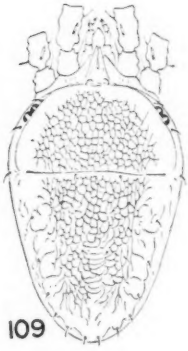
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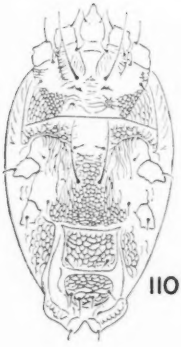
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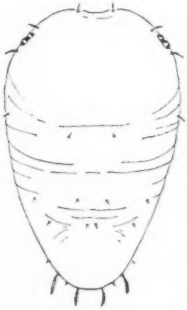
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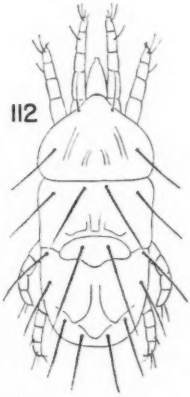
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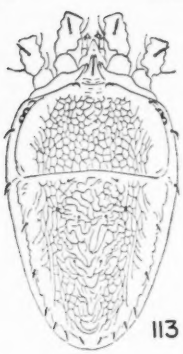

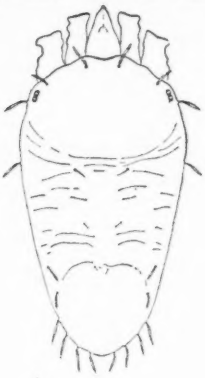

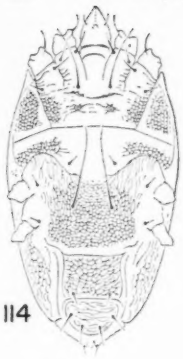

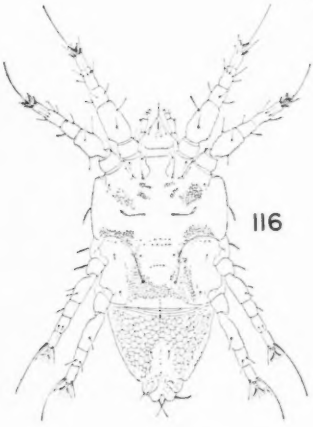

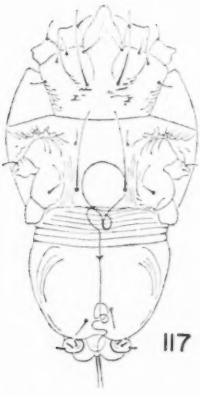

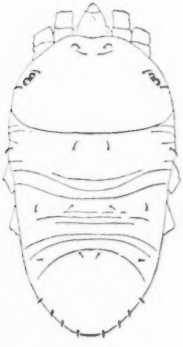

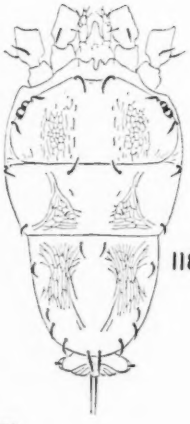

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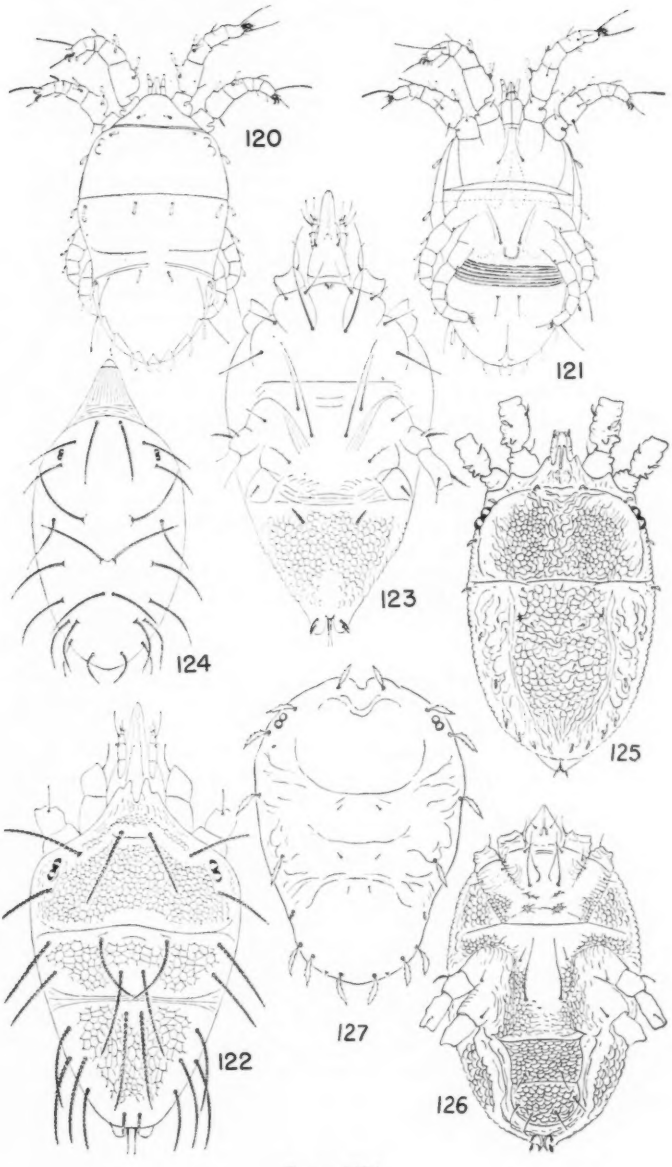

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Retention of the "Color" Pattern in an Albino Thirteen-lined Ground Squirrel (Citellus tridecemlineatus)

Donald F. Hoffmeister and M. Max Hensley

Museum of Natural History, University of Illinois, Urbana

Albinism in thirteen-lined ground squirrels, *Citellus tridecemlineatus*, is not rare. On the golf courses in Urbana, Illinois, and Tulsa, Oklahoma, albino squirrels have reportedly been seen for a number of years. Undoubtedly at other places, albino ground squirrels have been seen, but their occurrence apparently has not been reported in the literature. It is not albinism in *Citellus tridecemlineatus* that we are primarily interested in recording here, but the unusual condition in such an albino wherein the typical pattern of stripes and spots is retained even though the animal lacks all pigmentation. Figure I shows this striped albino alongside a normally-pigmented squirrel. Except for a few small light spots lacking in the head region, the pattern, but not the color, in the albino is typical of that of the normal squirrel.

The albino ground squirrel was captured alive on July 4, 1947, on the Urbana golf course, Champaign County, Illinois, by A. Hanson and L. Nelson, and was presented to the Museum by Mr. R. W. Pfeiffer. The squirrel was a young animal that most likely was born in the spring of the same year. The eyes and claws were pink and the skin lacked pigmentation. In captivity the animal thrived, but on August 12, 1947, it escaped and a pet red fox killed the squirrel when catching it.

In the live animal, the stripes and spots were as distinct as they are in the preserved study skin. Our curiosity was aroused as to why this pattern should be retained in an albino. Examination of hairs from this specimen bears out that pigment was absent. Likewise this examination indicates, as near as we can determine without sectioning the hairs, that, structurally, the hairs are the same as in normally pigmented specimens. The medulla, for example, is comparable in its width and distribution throughout the hair. In the albino, no structural differences in hairs from the light stripes and those from between these stripes can be noted. Thus, if our determinations are correct, the pattern of lighter stripes and spots is not the result of differences in light refraction due to structural differences within the hairs. The fact that the hairs are broader by nearly 50 per cent and apparently more numerous in the albino than in other squirrels would seemingly not be important in causing the spots and stripes to appear whiter, for the hairs are broader and more numerous over all of the dorsum of the albino.

Hairs in the lighter, whiter stripes and spots of the albino are longer by 23 per cent, on the average, than hairs elsewhere on the back, whereas in the normally pigmented squirrels, hairs from the stripes and spots are no longer

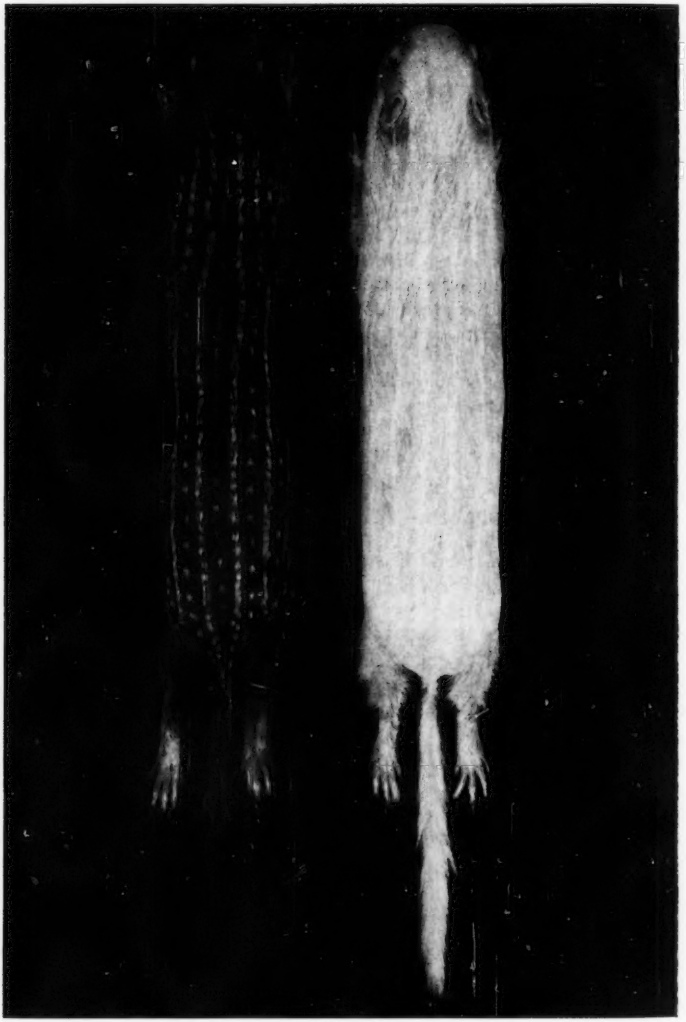

Fig. I.—Normally pigmented (left) and albino thirteen-lined ground squirrel, both of about the same age and size. Note the pattern of stripes and spots in the albino. Normal specimen, no. 5, M. B. Eyster; albino, no. 12, M. Max Hensley, both from Urbana, Champaign Co., Illinois, and in the University of Illinois, Museum of Natural History.

than the other hairs from the back region. In the albino, those hairs of greater length in the stripes and spots more completely cover the skin and thus prevent less of the pinkish color of this skin from meeting the eye. This results in whiter areas, forming the stripes and spots. Slightly clipping these longer hairs in some spots has caused these spots to lose their distinction as such. We can think of no reason why the hairs should have grown longer only in the areas of the stripes and spots, but such seems to have been the case and thus, in effect, to have preserved the typical markings or pattern in the albino.

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A Partial Bibliography of Natural History in the Chicago Region[1]

Louise G. Isfort

1004 Everett Ave., Louisville, Ky.

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Introduction

In the course of teaching for three years at Ferry Hall, Lake Forest, Illinois, and in leisure time, I enjoyed exploring the ravines, beaches, and nearby woodlands of the territory, which was new to me. In the latter part of my residence, a visit was made to the Waukegan moors, there was a week of camping on Lake Geneva, and an overnight camping trip in the Indiana dunes.

At about the midpoint of my sojourn in Lake Forest, I undertook this study with the purpose of becoming acquainted with the literature on natural history in the Chicago region, and as an aid to my teaching of biology. Familiarity with the literature, I believed, would provide a better knowledge of the natural history of the region: the geological development, present geographical features, and kinds of habitats and living creatures to be found. The names, works, and location of many of the outstanding scientists in the region would become familiar, and possible sources of information would be unearthed; that is, the kinds of publications and where they might be found. In all these ways, the undertaking proved of value to me.

The bibliography is believed to be accurate, for the works listed were checked by inspection, complete reading, or through a review. The list is, however, incomplete, since it attempts to include such a wide variety of subjects. I believe that it contains the outstanding works in each field, but the present bibliography can not carry specialized topics to their ultimate limit. In some fields, as in geology and botany, there is a copious literature; in others, there seems to be much less, and better coverage of these topics was possible.

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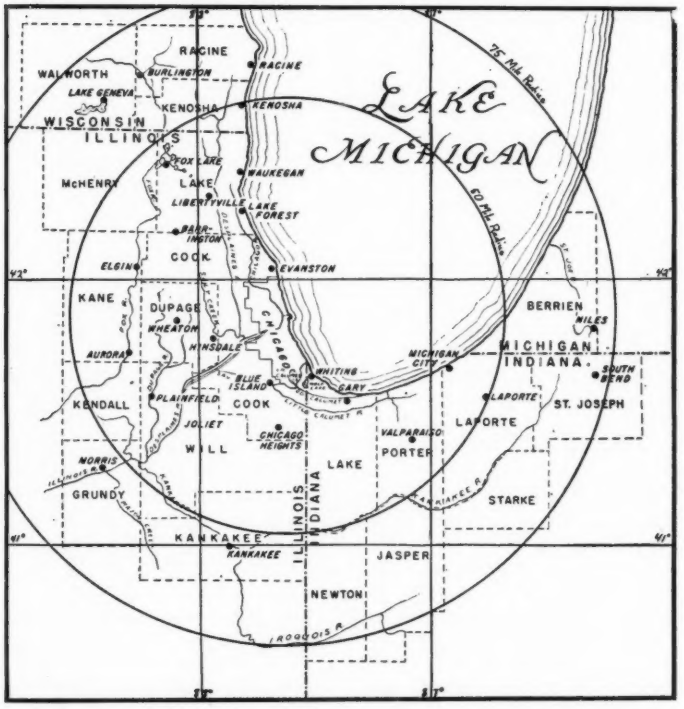
1 A thesis presented to the Faculty of the Graduate School of Cornell University in partial fulfillment of the requirements for the degree of Master of Arts, October, 1943, with revisions and additions.

ACKNOWLEDGEMENT

I wish to express my appreciation and sincere thanks for the suggestions and help of Professor Albert H. Wright in the search for material, in the use of libraries, and in criticizing the writing of this thesis. Thanks are due to friends who have helped in the collection of this bibliography.

This bibliography was originally intended to be modeled after Waldo Lee McAtee's publication entitled *A Sketch of the Natural History of the District of Columbia* (1918). It will be noted that there have been departures from the plan of the model, necessitated by the large amount of material found, for thirty years have passed since McAtee compiled his list. Thus, the bibliography is about three times as lengthy as that of the District of Columbia; and McAtee's second section, a discussion of the distribution of life in the District of Columbia region, finds no counterpart in this compilation for the Chicago region. There is, instead, a brief review of important or interesting aspects of natural history in the introduction to each section.

For convenience, the Chicago region is bounded as outlined by Walter L.



Map 1.—The Chicago Region.—50- and 75-mile distances from the Chicago "loop" are shown. (Map courtesy of the Chicago Natural History Museum.)

Necker in his recent check lists of amphibians and reptiles, and of mammals. We thus include nine counties of Illinois (McHenry, Lake, Kane, Cook, DuPage, Kendall, Grundy, Will and Kankakee), seven counties of Indiana (Lake, Porter, LaPorte, St. Joseph, Newton, Jasper and Starke), three in Wisconsin (Walworth, Racine and Kenosha), and one in Michigan (Berrien). A map showing the region is here included.

Early publications limited the region to parts of Illinois and Indiana adjacent to the lake, for transportation was slower, and the city itself and its suburbs had encroached to much less extent upon the natural character of the land. Later, scientists confined themselves to the circular area included by an arc drawn with a radius of fifty miles from the center of Chicago. More recently, writers include South Bend, the Kankakee River, most of the Fox River, and the Wisconsin and Michigan counties named above.

The history of this region is recent. Records of the early explorers begin with the year 1673, with notes in Père Marquette's journal (Jesuit Record 59). The Chicago portage was important to traders, and in 1779 Point Sable began a period of residency within present-day Chicago limits, running a trading post. The story of Fort Dearborn and the Dearborn massacre (1812) is well known. In 1837, at the time of organization as a city, the population numbered 4,170. Growth has been rapid, because of Chicago's advantageous position on the lake, between eastern and western drainages, in great farming and industrial areas; and because of its situation as a railroad center. It is now the second largest city in the nation, numbering 3,396,808 people in the 1940 census, and possessed of the complex developments inevitable to a city of its position and size. Its very presence affects the course of events over wide areas outside its city boundaries.

Within the Chicago region, we find a variety of ecological communities, often due partly to the slight differences in the nearly uniform geological surfaces. Thus we have the natural regions shown on the accompanying map: besides the Lake Michigan waters, (1) xeric beaches, dunes, large and small ravines, young streams, swamps and sluggish rivers on the lake plain; (2) a narrow lake border upland in the north; (3) the Valparaiso upland, which runs parallel to the shore along the Valparaiso moraine, a low continental divide cut only by the Des Plaines River and the Chicago Outlet; (4) the Manteno plain, slightly lower than the Valparaiso upland; southwest of this, (5) a plain bordered by the swamps (many now drained) and meandering river of the Morris-Kankakee basin; and finally, (6) the outer uplands.[2] This is the meeting place of the deciduous forest and the prairie, with remnants of coniferous forests, and swamps containing old pollen records of the changes in forest type which accompanied glacial invasion and retreat. The scarcity of bed rock at the surface limits the life of this type of environment to a few localities. Altogether, this meeting place of north, south, east and west contains much of interest to the student of natural history.

The scientific study of natural history in the Chicago region began with Robert Kennicott's list of vertebrates and mollusks published in 1855. Kennicott (1835-1866) was keenly interested in the living creatures he found and

2 Fryxell, 1926.

his studies with his father, and with Hoy and Kirtland, prepared him for accurate observation of life histories and speciation. His opportunity for two winters' work with Baird at the Smithsonian Institution was fruitful. Besides his scientific abilities, Kennicott had personal charm, was an inspired teacher, and a leader. By the time of his death at the age of thirty-one, he had been a moving spirit in the founding of a natural history museum at Northwestern University, and in the founding of the Chicago Academy of Sciences, where

Map 2.—Natural Regions in the Chicago Area.

he was a curator, director and trustee; and he had been on three expeditions as a naturalist, two of these being trips to Alaska. It was on the last of these that he died; this blow, and the Chicago fire, which destroyed the natural history collections, set back for a time the development of the Chicago Academy of Sciences. The dates of the founding of other scientific institutions in the region will be noted in the bibliography.

Some mention should be made of the arrangement of this bibliography. It will be noted that the works are grouped according to subjects of natural

history, the ancient and inanimate first, then ecology, plants, and invertebrate and vertebrate animals. In each group, the list of works is arranged alphabetically. There are a few works which belong in more than one section, and this necessitates repetition. Ecological literature, however, has been listed only under that section, so that for a complete survey of any other subject the ecology list should also be consulted.

Much of the material was located in the John Crerar Library, Chicago, the Chicago Natural History Museum, Cornell University, and in New York and Philadelphia libraries.

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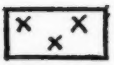
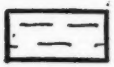
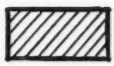
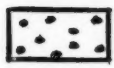
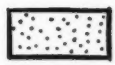
Regions in order of increasing elevation above sea level:

Lake Plain	500' - 700'	
Morris-Kankakee Basin	500' - 700'	
Lake Border Upland	600' - 700'	
Manteno Plain	600' - 700'	
Outer Upland	600' - 800'	
(in the north, 800' - 1000')		
Valparaiso Upland	700' - 900'	
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(Regions after Fryxell, 1926; drawn on map, courtesy of the Chicago Natural History Museum)

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GEOGRAPHY, GEOLOGY AND FOSSILS

Chicago and its surrounding territory are at the center of the "Central Lowlands." The various states of which the region is a part have low mean elevations (Illinois, 600 feet; Indiana, 700 feet; Wisconsin, 1050 feet).[1] The surface is smooth, except for knolls less than fifty feet in height and, bordering Lake Michigan, sand dunes that rise to 200 feet above level land.[2] The highest elevations are found in Walworth county, near Lake Geneva, and in Kane county (1,000 to 1,200 feet).[3] In the depressions of the drift are many lakes, characteristic of northern Indiana and Illinois and southeastern Wisconsin. They lie between the dune belts or beaches of Lake Chicago and Lake Michigan.

The area lies in the region of the largest system of fresh water bodies in the world. It includes the divide between two great drainages, that of the Mississippi and of the St. Lawrence rivers. The divide is formed by the Valparaiso moraine, the oldest beach of ancient Lake Chicago. The North Shore Railroad and the Chicago and Northwestern Railroad follow the summit of the divide directly north from Chicago. Across this moraine drains the Chicago Outlet. The Outlet includes the Calumet and Sag rivers, the canal made up of the old Illinois-Michigan canal (100 miles long, from the Chicago River to La Salle, dug 1836-1848), and the Chicago Drainage Canal (28 miles long, from the eastern end of the first canal to the Des Plaines River at Lockport, dug 1892-1900), the lower Des Plaines River, and the upper Illinois River. The waters of northern Indiana drain into the Kankakee River, which joins the Illinois. The Chicago River originally flowed between north and south parallel ridges left by glacial erosion. The Fox flows south and southwest, to join the Illinois outside the region. Much of the narrow strip of land around Lake Michigan drains into the lake by small streams, running through ravines along the North Shore of Chicago.

The surface of the region is composed mainly of ground and terminal moraines, deposited by the Michigan lobe of the great glacier in the Wisconsin glacial stage. The drift varies widely in depth, up to 500 or 600 feet in Berrien county, Michigan; seldom do dug wells in most parts of the region reach rock.[4] In the three southwestern counties, alluvium deposited by an ancient stream that flowed out of Lake Michigan lies on the surface. Rock outcrops are principally Silurian. There are coal measure outcrops in the four southwestern counties.

The soil surface in general bears no relation to the shape of the rock underneath, due to the thickness of the glacial drift. The rocks were formed in Paleozoic times, and fossil records are of invertebrates and primitive plants, except for two species of a small, primitive fish found near Elmhurst,[5] and the fossils of the southwestern coal measures. The rock layers are nearly horizontal, with a slight dip to the northeast. The rock is Ordovician under western Walworth, Kane and most of Kendall counties, and Silurian in most

1 Fryxell, 1926.
2 Leverett and Taylor, 1915.
3 Fryxell, 1926.
4 Leverett and Taylor, 1915.
5 Nichols, 1925.

of Wisconsin and Illinois, and in western Indiana. Under central and eastern Indiana in this region, and under Berrien county, Michigan, is Devonian rock.[6] Geological evolution has been quiet and slow, characterized by the going and coming of shallow seas without local or violent upheaval of land.

The lowest sandstone layers were formed in the Cambrian era. Ordovician rocks are several hundred feet thick in the vicinity of Chicago. In Silurian time, elevations in the New England, Cincinnati and Ozark regions shut out the sea from these directions; the northern waters were warm, and in this period the Niagara dolomite limestone was formed, rich in fossils of invertebrates of the time. The layer is 250-400 feet thick in the Chicago district, and has been studied in quarries and outcrops, and in the cut of the Drainage Canal near Lockport.

A unique fossil bed is found at Mazon Creek in Grundy county, Illinois. The fossils are in ironstone nodules lying in shale of the Pennsylvanian period. They are predominantly of fern-like plants, with invertebrates, fish, and amphibian remains in much lesser numbers.[7] These nodules are now abundantly exposed in the operations of "strip-mining" for coal.

Later geological deposits have completely disappeared, due to erosion. Evidence indicates that the land was raised from 2,000 to 3,000 feet above its present altitude at the end of the Paleozoic, showing the extent of erosion before glacial times. The Illinoian and Wisconsin drifts covered the region in the Pleistocene.[8] Near Aurora and Minooka, bones of the mastodon, giant beaver, deer, elk and bear have been excavated as relics from the Wisconsin glacial stage, together with the shells of mollusks.

Economically, the coal beds in the southwest are important. The marl deposits of the lake borders are used by cement mills, and some of the earth in Illinois is used by the relatively new mineral wool industry. Clay and loam are used in brick making. Sand, gravel, and building stone are used in construction. Potter's clay is found, and limestone is burned to prepare lime. Underground waters in the St. Peter's limestone under the Cincinnati and Niagara layers are abundant and pure, and artesian wells are drilled by farmers and for public supplies.[9] There is peat on the borders of lakes and in poorly drained situations. Swamps have been drained to bring land under cultivation, and, soil and climate being favorable, agriculture is carried on.

The weather of the region is changeable, for the path of storms lies across it. The following table, taken from Fryxell, shows conditions at Chicago:

Weather Conditions at Chicago[10]

	January	April	July	October
Average maximum temperature	31 (low)	54	80 (high)	61
Mean temperature	24 (low)	47	73 (high)	54
Average minimum temperature	18 (low)	38	66 (high)	47
Average wind velocity	16 MPH	16 MPH	12 MPH	15 MPH
Mean precipitation, inches	2.02 (low)	2.78	3.36 (high)	2.58

6 Fryxell, 1926.
7 Moodie, 1916.
8 Nichols, 1925.
9 Leverett and Taylor, 1915.
10 Fryxell, 1926.

The rainfall averages 30 inches a year, and is ordinarily well distributed for agricultural purposes.

Interest in the geology and fossils of the Chicago area was shown early. We find a large proportion of the publications at this time issuing from the Chicago Academy of Sciences. The United States and State Geological Surveys have made notable contributions. The men who conducted these researches may be noted from the list of authors below.

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ECOLOGY

The Chicago region lies principally in the deciduous forest biome, with the western portion in the grassland. It is near the eastern tip of the prairie peninsula.[1]

The region is of interest ecologically for three, or possibly four, principal reasons. The large dune area is unique; it provides opportunity for study of plant succession, both at the edges of the dune area to find the steps in the change from dune to deciduous forest, and in the dunes themselves to find the manner in which permanent dunes are established. The habits of the animals of the dune fauna are of interest. The first important publication on this association was by Henry Chandler Cowles.[2] Shelford's *Animal*

1 Transeau, 1935. See botany bibliography.

2 Cowles, 1899.

Communities of Temperate America[3] introduced ideas of community succession and is a pioneer ecological work on the Chicago region. Strohecker[4] gives the succession of plant communities in the change from beach to forest climax, and the effect on Orthopteran species.

Second, the region is a critical one for northern and southern species, since the northern plants that invaded the south with the advance of the last glacier have remnants of a southern limit here, especially in these most southern of the sphagnum bogs, and many southern species have advanced this far north and surrounded them. The same has been found true of certain animals. For instance, Ross[5] states that Chicago has the most southern of the northern insect species. This conjunction of northern and southern forms is evident in the dunes area. To quote Cowles[6]: "Here one may find the prickly pear cactus of the southwestern desert hobnobbing with the bearberry of the arctic and alpine regions. The commonest pine of the dunes, the jack pine, is far out of its main range, reaching here its farthest south. One is startled at the number of plants from the far north, many of which, like the jack pine, are not found southward of our dunes. Among such plants of the Canadian forest and tundra are the twin flower, the glandular willow, the poverty grass, and the northern rose. Northern plants are particularly characteristic of the dune swamps, and embrace such species as the larch, bunchberry, dwarf birch, sage willow, numerous orchids, cranberry, leather leaf and many more. Many of these species are found nowhere for many miles outside of the dune region." According to Ray C. Friesner,[7] 459 species of plants reach a range limit in the lakes area of Indiana. The factors controlling the distribution of these critical species may be determined here, if anywhere, and many observations have been made in this attempt. This has contributed to an understanding of life zones or biomes.

Third, the conjunction of western prairie and eastern deciduous forest makes possible studies, in areas not widely separated, of the factors which prevent any one of these life forms from encroaching on another.

Fourth, the inclusion of the southern tip of Lake Michigan in the region has brought the study of Great Lakes' problems into the area.

As a result, we have many straightforward studies of typical areas: dune, swamp, bog, pond, deciduous forest, prairie and intermediate stages, as well as Lake Michigan itself. Shelford[8] has made a series of studies on fish succession in streams and ponds. Stephen A. Forbes' *The Lake as a Microcosm*[9] (reprinted in 1925) describes the fish ecology of the lakes in northeastern Illinois and the Wisconsin counties of the Chicago region.

There are many over-all studies in distribution of individual species of plants, insects and vertebrates. Studies have been made of certain insect-

3 Shelford, 1913.
4 Strohecker, 1937. See Orthoptera bibliography.
5 Ross, 1941.
6 Mather, 1917, p. 44.
7 Friesner, 1936.
8 Shelford, 1911a, b, c; 1914.
9 Forbes, 1925.

plant relationships such as pollination and the formation of galls, migration of individual species, the effects of biotic relationships, climatic changes, draining of swamps, encroachment of industry and suburb, and problems of conservation. Agricultural problems involving epidemics of pests and their control might have been included here, but will be found in the sections on botany and insects.

In this section are listed laboratory studies on ecological factors, principally by Dr. Orlando Park of Northwestern University and his students.

Thus we may trace in the literature the exploration of different kinds of associes with their distinctive groups of the flora and fauna, and the growing understanding of the ecological relationships of the species, the order of succession, and the environmental factors attending those changes. Along with this development, the general ecological concepts are maturing. Cowles was a pioneer in the development of association and climax concepts,[10] and in adherence to mechanical causation.[11] Shelford[12] applied and developed the biome concept.

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10 Cowles, 1901a.
11 Cowles, 1911.
12 Shelford, 1931b; 1932a, b; Shelford and Olson, 1935.

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BOTANY

The literature, as will be seen by scanning the bibliography, includes floras of the region, and state floras. Specialists have worked upon various thallophyte groups (algae, phytoplankton, mushrooms, parasitic fungi), upon bryophytes, and upon spermatophytes (trees, shrubs, grasses, weeds), but there is very little on pteridophytes.

The centers of study, and areas attracting most interest, have been Chicago and its immediate environs; the Indiana dunes, for which Peattie's work is available; the Waukegan moors and flats; and the Notre Dame environs at South Bend, where Nieuwland worked for many years.

There are several outstanding Indiana and Illinois floras, and special mention should be given to Charles Deam, and to his work. Pepoon's *Flora of the Chicago Region* (1927) with Buhl's *Supplement* (1934) includes only five counties of our area, but is a very useful book, with detailed descriptions of the six floral areas distinguished by the author, as well as keys and plant lists. Herbert's *Flora of Berrien County* treats the northeastern corner in our region, and is the only work found that is devoted to natural history of this county.

The variety of the plant life in the Chicago region is indicated though not fully shown by the following data: Pepoon (1927) listed 1902 spermatophytes and pteridophytes for the immediate Chicago environs. Buhl (1934) slightly enlarged the area, and increased the number of plants to 2015. Mary Stella Hague (1929, 1937) cites records for 158 species of mosses and 28 species of liverworts in our Illinois counties. Moffatt (1909, 1923) lists 412 species of Basidiomycetes from the Chicago region. Britton (1945) has records for 530 species of algae in the Illinois counties. Additions to these may be noted in other publications.

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INVERTEBRATES EXCLUSIVE OF INSECTS

The invertebrate life of the Chicago region is incompletely represented in this bibliography. This unfortunately appears to give a true idea of progress in the field; my sources have not yielded more than the information here given.

Mollusks have received the most attention. Frank Collins Baker (1906) gives records for 252 species (92 Pelecypoda, 160 Gastropoda) from the Illinois counties of the Chicago area. His discussion of three distinct distribution areas in four adjacent counties is of interest (1898). Each of 39 of the mollusk species is confined to some one of these areas, absent from the other two. The areas are the three main drainages of the counties investigated: that of the Chicago River, the Des Plaines and Illinois Rivers, and the swamp area and Calumet River. There are differences in the character of land in each section that partially account for the differences in species.

Crustacea and Arachnida have been studied to some extent. There is little or no information available for the remaining groups.

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INSECTS

The earliest entomological publication listed here for the Chicago region is William Le Baron's *First Annual Report of the Noxious Insects of the State of Illinois* (1871), in which he reports the oyster-shell bark-louse in DuPage county.

Pertinent literature on insects has been issued by the State Entomologist

of Illinois. For many years, observations were made principally in the central part of the state, but in the 1911 report we find Davis had attacked the problems of the Chicago region pertaining to truck farms and vegetable farms. In 1912, the pests of flowering and ornamental greenhouse plants were studied. Reports by the State Entomologist of Indiana contain material on insect epidemics in the northern counties of that state.

Entomological works for Illinois, Indiana, Wisconsin and Michigan have included mention of insects of our Chicago area. Outstanding entomologists of these states are S. A. Forbes (mainly in central Illinois, however), T. H. Frison and W. S. Blatchley. Others have contributed materially. Monographs dealing with Illinois insects, by T. H. Frison and others, are now in preparation.

As is evident, there is opportunity for a great deal of work in this field, for the literature is meager in proportion to the numbers and importance of the insects. In order to give a more complete bibliography, some works on wider areas which include the Chicago region have been added. Needless to say, there remain many publications on various insect groups found in northeastern United States, which a lack of time prevented me from examining.

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FISHES

The fishes of the Chicago region belong to varied types of fresh water habitats: Lake Michigan, smaller lakes and ponds, clear and sluggish streams, and rivers. A large number of species could be expected, although careful comparison of the literature gives the following numbers:

	Total Species	Species Added
Within 50 miles of Chicago[1]	105	105
Illinois counties[2]	97	17
Indiana counties[3]	77	5
Lake Michigan and tributaries[4]	131	37
Total in Chicago area		164

Many of the fishes are widely distributed. In studying the fishes of Illinois, Forbes and Richardson (1908) found some species of this region and south to the Sangamon River to be different from those still farther south in the lower Illinoisan glaciation. Two factors were involved: the fact that southern streams dried up in midsummer drought, and the turbidity of the slightly acid water. Both factors are due to the geological antiquity of the area.

The fishes of the Chicago region are found in the drainages of Lake Michigan and the Illinois River, as well as in lakes with no outlet. A comparison of the species in these water systems has been begun by Shelford (1911).[5] The draining of all northern waters to the south in the past has been deemed partly to account for similarities among the systems. The slow

1 Meek and Hildebrand, 1910.
2 O'Donnell, 1935.
3 Blatchley, 1938.
4 Hubbs and Lagler, 1941.
5 Shelford, 1911a, b, c. See ecology bibliography.

recession of the Lake Chicago, or Lake Michigan, shores resulted in a series of parallel beaches or ridges and, at the southern end of Lake Michigan, isolated lakes and ponds with many similarities. This slow recession also accounts for the fact that the lakes farthest from the parent lake are the most mature, while those nearer the parent lake have the pioneer species.[6]

Shelford,[7] by investigation of Lake Michigan tributaries, has discovered the ecological communities of fishes that succeed one another as one progresses down a stream, or as time goes by at a given point on a stream and the bed develops farther back into the land. At the first or headwater station in streams of varying ages he found horned dace, at the second red-bellied dace, at the third black-nosed dace and Johnny darters, and so on. Thus, as one compares species found in various streams, the communities succeed one another with a high degree of order, the members of any given community being of similar form and habit. Shelford suggests that there are pioneer ecological types, young types, those preferring considerable humus, and types best able to withstand drought.

Several authors mention increasing scarcity of some species and the disappearance of others, caused or increased by stream pollution, drainage, deforestation, and destruction of the food supply.[8] The most outstanding case of pollution is the result of Chicago's disposal of wastes, which first were emptied into Lake Michigan, and then diverted to the Illinois River, through the Chicago Outlet via the Drainage Canal. Restocking of suitable lakes and streams is carried on, and foreign species have been introduced.

The region is not of first importance for its commercial fisheries, but the food fishes are of value. Following is a table of the food fishes rated according to quality and abundance, adapted from Forbes and Richardson (1908).

ILLINOIS FOOD FISHES

(Nomenclature and order according to the *Check List of the Fishes* by Jordan, Evermann and Clark, 1930)

FIRST CLASS

Coregonus clupeaformis (Mitchill)
Cristivomer namaycush (Walbaum)
Ictalurus punctatus (Raf.)
Esox estor LeSueur
Stizostedion vitreum (Mitchill)
Huro floridana (LeSueur)

SECOND CLASS

Pomolobus chrysochloris Raf.
Amphiodon alosoides Raf.
Leucichthys artedi (LeSueur)
Anguilla rostrata (LeSueur)
Megastomatobus cyprinella (Cuvier and Valenciennes)
Micropterus dolomieu Lacépède
Helioperca incisor (Cuvier and Valenciennes)
Pomoxys annularis Raf.
Pomoxys sparoides (Lacépède)

THIRD CLASS

Acipenser fulvescens Raf.
Moxostoma aureolum (LeSueur)
Moxostoma anisurum (Raf.)
Ameiurus natalis (LeSueur)
Ameiurus nebulosus (LeSueur)
Ameiurus melas (Raf.)
Esox vermiculatus LeSueur
Chaenobryttus gulosus (Cuvier and Valenciennes)
Aplodinotus grunniens (Raf.)
Ictiobus urus (Agassiz)
Cyprinus carpio L.
Haustor lacustris (Walbaum)
Perca flavescens (Mitchill)

6 Shelford, 1911b, c. See ecology bibliography.
7 Shelford, 1911a, b, c. See ecology bibliography.
8 Hahn, 1910.

Cynoperca canadensis (Smith)
Apomotis cyanellus (Raf.)
Xenotis megalotis (Raf.)
Eupomotis gibbosus (L.)
Ambloplites rupestris (Raf.)
Lepibema chrysops (Raf.)
Chrysoperca interrupta (Gill)

FOURTH CLASS
Amia calva L.
Dorosoma cepedianum (LeSueur)
Carpiodes thompsoni Agassiz
Catostomus commersonnii (Lacépède)
Minytrema melanops (Raf.)
Lota maculosa LeSueur)

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AMPHIBIANS AND REPTILES

The species and subspecies of amphibians in the Chicago area number twenty-one, and the reptiles thirty-one, compared with 167 and 444, respectively, in North America north of Mexico. There are still many areas to be explored and studied, and many life history notes to be made before the study is complete.[1]

For these two classes of vertebrates, as for other organisms, the Chicago area lies along the boundary line of a number of species. A few reach their eastern limit: *Thamnophis radix* has a triangular area of distribution, with the eastern apex at Chicago;[1] *Pituophis s. sayi* does not occur east of the Illinois-Indiana boundary in this region;[2] and *Terrapene ornata* is found in sandy areas in Kankakee county, Illinois, and in Lake county, Indiana, east to Lake Maxinkuckee.[1] *Ophisaurus ventralis* is at both eastern and western limits.[3]

Hemidactylium scutatum is nearly at its western limit;[3] *Eurycea b. bislineata* is at its extreme western limit.[2] *Bufo woodhousii fowleri* does not extend farther west at this latitude.[4] *Thamnophis butleri* is not found west of the Indiana-Illinois boundary in the Chicago area.[2] *Clemmys guttata* does not occur west of the region, [5, 2] though early records from Wisconsin are judged to be erroneous.[1] *Terrapene carolina* is recorded from Indiana only,[1] and may not extend farther west.

Few species reach a southern limit here. *Diadophis punctatus edwardsi* occurs south to Milwaukee County, and may be found in this region, though authentic data are lacking.[1] There are several that reach a northern limit: *Eurycea b. bislineata*,[3] *Ambystoma opacum*[6] and *Siren intermedia nettingi*[2] among the amphibians; from the reptiles, *Ophisaurus ventralis*,[3] *Coluber constrictor flaviventris*,[3] *Natrix grahamii*,[3] *Natrix kirtlandii*[7] and *Pseudemys scripta troostii*.[1]

Here, the subspecies *Chrysemys picta marginata* intergrades with the western subspecies *Chrysemys p. bellii*, with typical representatives of the former in the Indiana dunes.[5] The eastern form *Opheodrys v. vernalis* intergrades with the western *Opheodrys v. blanchardi* along a line connecting the present eastward extensions of the prairies. From southeastern Wisconsin come specimens of the eastern form; in Illinois intergrades more western than eastern are found; and in Indiana the western form.[8]

Doubtful species in this region are *Rana areolata, Carphophis amoena helenae, Diadophis punctatus* ssp. and *Crotalus horridus*.[1] *Ambystoma opacum* has become authentic.[6] Recently, Minton (1944) has listed

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1 Schmidt and Necker, 1935.
2 Pope, 1944.
3 Chicago Natural History Museum exhibit, 1942.
4 Wright and Wright, 1933.
5 Schmidt, 1938.
6 Necker, 1939b.
7 Davis and Rice, 1883.
8 Grobman, 1941.

Sceloporus undulatus (introduced), *Kinosternon s. subrubrum* and *Trionyx spiniferus* for the Chicago area. Pope (1944) reports a single, small specimen of *Siren intermedia nettingi* from Porter County, Indiana.

Necturus m. maculosus is found abundantly in Lake Michigan, though eggs and larvae had not been found in the area until Necker (1939b) published an account of eggs at Chesterton, Indiana.

In 1917, Ruthven suspected the presence of *Bufo woodhousii fowleri* in Michigan, Berrien County included, and the range of this toad was later extended to include this area. Schmidt in 1929 named it as one of the common Salientia of the area.

It is interesting to note that in 1883 Davis and Rice listed *Plethodon cinereus* as two subspecies; and *Triturus viridescens* as *Diemyctylus m. miniatus,* Raf., red eft, and *Diemyctylus m. viridescens,* spotted eft. Schmidt and Necker (1935) state that there is no red eft land stage in this region as there is to the east, and also no axolotl stage for *Ambystoma t. tigrinum* as in the west.

Between Kennicott's list in 1855 and Schmidt's publications of 1929 to 1938 we find only state works, so that for earlier information one must consult publications on each of the four states included in the region and study statements of distribution. Illinois' literature begins with Kennicott (1855), and continues with the list by Davis and Rice (1883). Garman, in 1892, made a synopsis for the state. Then, there is a long gap, except for Bertram G. Smith's study in 1911. At present, the State Natural History Survey Division and the Chicago Academy of Sciences are making a study to publish new data and a complete work for the entire state (Gloyd, 1941). Cahn (1937) treated the turtles of Illinois in detail, and the State Conservation Department has brought out a manual of Illinois snakes (1941).

For Indiana, Hay published a classic in 1892, brought up to date by Myers in 1926. Major Chapman Grant, while stationed in the state, added information in his *Herpetological Notes* (1935); Sherman Minton, Jr. (1944) has made further additions.

In Wisconsin, Hoy (1883) made the early publication, just before Higley's and Garman's works. T. E. B. Pope has made noteworthy contributions, and Pope and Dickinson's work (1928) is a complete one for the state, but uncritical according to Schmidt (1935), as doubtful records are accepted.

For Michigan, Ruthven, Thompson and Gaige's *Herpetology* (1912 and 1928) is excellent, though on a small part of our region.

Many publications on the Chicago area have been written since 1929 by Schmidt and Necker, to create interest in amphibians and reptiles as well as to add to the records. Schmidt and Necker (1935) and Necker (1939b) give field data on both classes for this region. Pope (1944) has written a book in nontechnical language, including accounts of life histories, habits

and economic importance along with descriptions of species and subspecies and statements of distribution.

Karl Schmidt[9] has used the present distribution of the amphibians and reptiles to determine postglacial extensions eastward of the prairie.

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9 Schmidt, 1938. See ecology bibliography.

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BIRDS

This group has evidently excited more general interest than any other animal group, if one judges by the literature found. In ornithological publications such as *Auk, Bird Lore,* the *Wilson Bulletin* and Audubon society periodicals, as well as the *American Midland Naturalist, Chicago Naturalist* and others, a wealth of notes is recorded on observations of nesting, migration and other habits and characteristics of interest. These sources are by no means exhausted in the bibliography appended here.

The region has a goodly variety of species, since it includes plains, forests, the lake, and river land. Birds common in one part may not be found in the others, because of this variety of habitat. The region is also fortunate in lying on one of the main migration routes between north and south. For the study of these migrating species, the Chicago Academy of Sciences' check

list (1939) gives much interesting information. The Academy also publishes a convenient field card (1935).

Nelson's list (1876) for Cook and Lake counties, Illinois, names 180 birds that nest in the area, 24 summer visitors not known to breed here, 69 that are migratory, and 76 winter visitants and residents. The next publication on the area is Woodruff's (1907), and the latest is by Ford, Sanborn and Coursen (1934). In the last, 317 species are named, and of these 92 are not common.

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MAMMALS

The mammals of the Chicago region number approximately 53; in addition, ten species have become extinct within historical times. The regionally extinct mammals are the black bear, fisher, marten, timber wolf, Canada lynx, cougar, bob cat, beaver, elk, and bison. Deer, red and grey fox, coyote, otter and badger are rare. Many existing forms, such as shrews, are unfamiliar, because of their secretive and nocturnal habits. The most numerous forms belong to the order of rodents, which unfortunately contains many undesirable creatures.

A number of animals seem to reach a distributional limit in this region, or on the border of the region. The most recent authority is Hamilton (1943).

Four mammals reach a southern limit here: Bonaparte's weasel (*Mustela cicognanii* Bonaparte), the grey squirrel (*Sciurus carolinensis leucotis* Gapper), deer (*Odocoileus virginianus borealis* Miller) in southern Michigan; and the rufescent woodchuck (*Marmota monax rufescens* Howell), which gives way to the southern woodchuck (*Marmota m. monax* L.) in the southern part of the region.

Four mammals reach a northern limit here: the opossum (*Didelphis v. virginiana* Kerr), the pipistrelle (*Pipistrellus s. subflavus* F. Cuvier), Rafinesque's bat (*Nycticeius humeralis* Raf.), and the southern woodchuck.

Three western subspecies have an eastern limit in the region: the western raccoon (*Procyon lotor hirtus* Nelson and Goldman), the Illinois skunk (*Mephitis mephitis avia* Bangs), and the Mississippi valley mink (*Mustela vison letifera* Hollister). These western subspecies merge into the eastern forms. The records show Hoy's pigmy shrew (*Microsorex hoyi hoyi* Baird) to be at its eastern limit in the region, though it is suspected of being present in southern Michigan. The eastern form is found in Ohio and eastward. The gray gopher or Franklin's ground squirrel (*Citellus franklini* Sabine) reaches its eastern limit in Indiana and has no representative to the east.

At a southwestern limit we find the least weasel (*Mustela rixosa allegheniensis* Rhoads), and the northeastern chipmunk (*Tamias striatus lysteri* Richardson) which borders the eastern boundary of the grey chipmunk (*Tamias striatus griseus* Mearns) in this region. There seem to be two other animals at a northeastern limit: Bachman's shrew (*Sorex longirostris longirostris* Bachman), and the pocket gopher (*Geomys bursarius illinoensis* Komarek and Spencer).

Lyon (1933) gives us an interesting history of North American mammals, accounting for their presence principally by the existence of a land bridge between this continent and Asia in prehistoric times, and by the effect of the glaciers on their subsequent distribution. In glacial and

postglacial times, all life zones have passed through this region. The forms found in Indiana today are divided into four groups, according to their geographical extraction: those of general world range, Eurasian, related to Eurasian, and South American.

The larger publications are, with few exceptions, state-wide in scope. Cory (1912) dealt with the mammals of Illinois and Wisconsin, Necker and Hatfield (1941) with Illinois, and Burt (1946) with Michigan. For Indiana, we have publications from Butler (1895), Hahn (1909), and Lyon (1936), the latter giving a wealth of natural history information, complete data on distribution, and locations of specimens and literature. Hamilton (1943) gives natural history notes, and fine distribution maps for each species and subspecies in the United States east of the Mississippi River. Sanborn (1929) and Gregory (1936) wrote of the Chicago region as a unit.

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MAN

Lyon[1] states that *Homo sapiens americanus* is "extinct in the wild condition." Little is known about the builders of the prehistoric effigy mounds of northern Illinois and Wisconsin, or the small burial mounds and fortifications; neither is their purpose understood. The Potawatomi formerly inhabiting this region are now in the Oklahoma reservations, in Kansas, Iowa, Wisconsin, or Canada. In 1910, this scattered tribe comprised 960 full-blooded persons and a total of 2,440. The Miami were represented by only 226, 59 full-blooded, and the Illinois were not named (*Department of Commerce Report,* 1910).

The historic tribes of the region belonged to the Algonquian family, a linguistic stock which extended over a greater area in North America than any other group. The Illinois (Illiniwek, "men") were encountered by Allouez in 1667, Father Hennepin (1680), La Salle (1684), and other whites. De Gannes (1721) has written of their customs. Their culture combined that of Eastern Woodland Indians and that of the Great Plains Indians. They were scattered over southern Wisconsin, northern Illinois, and the west bank of the Mississippi River to the Des Moines River in Iowa. They had been driven from the Chicago region by the Iroquois before 1671, moving westward. They were reduced to about 150 in number before 1800, by the Lake tribes, in retaliation for the murder of Pontiac in 1769. In 1928 there were in Oklahoma about 150 half-breeds, who did not follow the customs nor know the language of the tribe.

The Miami (Wea band) had moved south from Green Bay, Wisconsin, and according to Father Charlevoix were settled in Chicagoua at the southern end of Lake Michigan by 1671. The band went south to the upper Wabash River, probably because of Sioux attacks, and at the close of the century the Potawatomi had moved in from the north. In 1764 the Miami were estimated at 1500, but in 1928 there were only 60 half-breeds in Oklahoma and 200 near Peru, Indiana. Both of these groups have abandoned ancient customs.

It is possible that the Fox Indians were in this region. There is mention of them, and of the Kickapoos, by Winsor (1895), as they made dangerous a portage of the region about the year 1721.

The Potawatomi (People of the Place of Fire) were important in the early American period. At the time of the first white settlement they inhabited the Chicago region. By the beginning of the nineteenth century, they had spread over the region. They made good friends to the French, and bad enemies to the English. Those who occupied the present Chicago site were the Prairie Potawatomi, also referred to as Mascoutens on old maps. These people were Potawatomi modified by contact with prairie tribes of Miami, Illinois, Sauk and Fox. They were the perpetrators of the Fort Dearborn massacre, while other members of their tribe protected some of the whites. After 1812, settlers and military forces encroached more and more on their area. The Blackhawk War of 1832 was the last flare of opposition;

1 Lyon, 1936. See mammal bibliography.

and a grand council at Chicago in 1833 ceded all the best lands of the chiefs and headmen of several tribes. Over a period of years, they received their annuities and left for their reservation in western Iowa, or fled to Canada or to their old northern Wisconsin territory. In 1846, the former were moved again to Kansas, and in 1868, into Oklahoma; hence the scattering mentioned in the first paragraph of this section.

Accounts of early explorers and settlers give first-hand information on the unspoiled historic Indian. Studies of mounds have been made by the Bureau of American Ethnology. Mr. M. G. Chandler visited the Potawatomi and related tribes on behalf of the Chicago Natural History Museum, and obtained excellent collections and data. The account in Mr. Strong's leaflet (1938) is based on these findings.

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Pollen Content of Moss Polsters in Relation to Forest Composition

Henry P. Hansen[1]
Department of Botany, Oregon State College, Corvallis

Introduction

Perhaps one of the most important problems in the reconstruction of prehistoric vegetation from pollen profiles of organic sediments is the degree of over- or under-representation of the several species recorded in the sedimentary column. There are several major factors that cause distortion of the picture of forest composition as manifested by the pollen profiles. These include the relative radius of pollen dispersal of the several species, the relative degree of pollen preservation, the direction of wind during the period of anthesis, and the relative amounts of pollen produced by the several species concerned. Yet other factors and conditions, too numerable to mention, are responsible for discrepancies in the accurate representation of species in adjacent forests. While all these sources of error are readily admitted by the pollen analyst, their distortion of the pollen record may be partially lessened by the slow rate of disposition of sediments and the number of years represented by the sample used for pollen analysis. Thus, annual variation in the amount of pollen produced may be nullified by a sample of peat representing several years of accumulation, predominance of one species due to wind direction one year may be offset by different wind direction the following year, and factors affecting reception and preservation may vary from year to year with a representative average over a period of several years. In the Pacific Northwest, the proximity of several associations to the sediments may tend to invalidate interpretation upon the basis of direct pollen proportions. Some of these errors may be reduced or eliminated by conservative interpretation. In the Pacific Northwest the writer has interpreted pollen profiles largely on the basis of long range and sustained trends. Fluctuations back and forth from level to level have been discounted or ignored with the feeling that they represent changes in local conditions due to external forces rather than to any widespread changes in forest composition. It is realized that fire and disease, particularly the latter when it is specific, may radically alter composition within a few years or less. This may change the relative abundance, increasing the proportion of the species that survive, but not actually increasing their abundance until the absence of competition by the former species has permitted them to expand.

The degree of distortion of the pollen profiles resulting from sources of error cannot be evaluated to any degree of accuracy. They are largely im-

1 The author is grateful to the John Simon Guggenheim Memorial Foundation for a fellowship during the year 1947-48 which enabled him to devote the time necessary to work out this project.

measurable and in some cases intangible, and consequently pollen analysts have been loathe to qualify their interpretations in the light of the known possibilities. Comparing the pollen proportions of the several species represented by recent pollen deposition with the forest composition, may shed some light upon the amount of error in limited areas. A device to trap the atmospheric pollen from day to day which has been set up within an area of known forest composition, pollen analysis of the living *Sphagnum* at the surface of a bog, or the analysis of moss polsters in favorable areas may help to give us an idea as to the degree of aberration in prehistoric pollen-bearing sediments. The kinds and proportions of pollen present should denote the radius of pollen dispersal of outlying species, the relative abundance of pollen produced, and the effect of wind direction at the time of anthesis. In regions of prevailing winds and different associations leeward and windward to the site of pollen accumulation, this influence may be evaluated.

METHODS

The purpose of this study is to show the degree of correlation between the present forest composition of a given area, and proportions of recently accumulated pollen preserved in moss polsters. So far as is known, only one comparative study of forest composition and recent deposition has been made in this country. Carroll (1943) found a fair degree of correlation between pollen content of bryophytic polsters and composition of a spruce-fir community in the Great Smoky Mountains. The area of the present study is in the McDonald Forest, located in the east foothills of the Oregon Coast Range, a few miles northwest of the city of Corvallis. The moist, warm climate of the Willamette Valley and Coast Range of western Oregon during the winter is favorable for a luxuriant growth of mosses, liverworts, and lichens. Trees, logs, and ground surface in the woods are literally covered with a dense layer of many species of bryophytes. The mosses continue to thrive until the dry weather of midsummer and are favorable for the reception and preservation of pollen from the surrounding forests.

A series of moss polsters was collected about the middle of May from various sites within the area of the forest in which the sample plots were taken. The polsters were about 6 inches square and consisted largely of the current year's growth, although in some cases the entire mat down to the tree trunk, log, or ground surface was included. The polsters were collected in a widespread pattern over the sample plot area, but with no regard to the location of the sample plots. Some were taken from logs, some from tree trunks, and others from the ground. They were taken in dense woods, in the open, in ravines, on knolls, on the south slope and on the north slope. Ten polsters were prepared for pollen analysis.

In preparation for microscopic analysis, the pollen and other fine material were removed from the moss polsters by violently agitating in about 1 liter of water. The moss polster was then dried and saved for reference. The pollen and other detritus were permitted to settle in the rinse-water, and about half of the water was decanted. To the remaining water, a few drops of potassium

hydrate and gentian violet stain were added, and it was boiled for about 10 minutes. The sediment was then strained, washed, and centrifuged, and the pollen-bearing detritus mounted in glycerine jelly. From 75 to 255 pollen grains were counted from each polster (table 3).

FOREST COMPOSITION

The chief dominant on the east slope of the northern half of the Oregon Coast Range is Douglas Fir (*Pseudotsuga taxifolia*), with western hemlock (*Tsuga heterophylla*), lowland white fir (*Abies grandis*), and western red cedar (*Thuja plicata*) locally abundant on favorable sites. Less common, but occurring on a few isolated sites are noble fir (*Abies procera*) silver fir (*A. amabilis*), and western white pine (*Pinus monticola*). The only one of the last three that occurs near the area of this study is noble fir, which forms dense forests at upper timberline on Mary's Peak, about 10 miles southwest of the McDonald Forest. In the Willamette Valley Oregon white oak (*Quercus garryana*) is the most common broadleaf tree. It extends into the foothills, occupying the dryer south slopes and clearings on north slopes, and forms dense, pure stands on the valley floor.

In the immediate area of study, which involves the contiguous parts of 4 sections, Douglas fir and lowland white fir form the uppermost canopy, while bigleaf maple (*Acer macrophyllum*) and white oak form the next lowest stratum. On floodplains adjacent to the area red alder (*Alnus oregona*), Oregon ash (*Fraxinus oregana*), and cotton wood (*Populus trichocarpa*) are predominant. The lowest arborescent stratum in the area consists of western yew (*Taxus brevifolia*), madrona (*Arbutus menziesii*), and the flowering dogwood (*Cornus nuttallii*). The highest shrub layer is composed of cascara (*Rhamnus purshiana*), bitter cherry (*Prunus emarginata*), black haw (*Crataegus douglasii*), and vine maple (*Acer circinatum*). A second, lower frutescent stratum is also present, but pollen of the lower arborescent and the two frutescent layers is largely absent in the moss polsters analyzed.

In the northeastern part of the McDonald Forest about 4 miles from the area of this study is an arboretum in which there are many species of conifers not native to the Willamette Valley, including 22 species of pine. Also in the city of Corvallis and on the Oregon State College campus a few miles away are hundreds of species of trees not native to western Oregon. There are also many orchards in the adjacent Willamette Valley, including wind-pollinated species such as filbert and English walnut, but apparently the prevailing westerly winds have largely prevented the pollen of these trees from reaching the area where the moss polsters were collected.

RESULTS AND CONCLUSIONS

The statistical data to determine the quantitative relationships of the principal arborescent species were obtained by taking 100 sample plots, 25 feet square over the area (Sprague and Hansen, 1946). A box azimuth compass was used and plots taken at 3-chain intervals. The data obtained from the quadrats include frequency, abundance, basal area, and size classes, the first three

based upon trees 1 inch and over DBH (table 1). Douglas fir is the most homogeneously dispersed with a freqeuncy of 76 per cent, while white oak is next with a frequency of 71 per cent. Big-leaf maple and lowland white fir are next with frequencies of 20 and 15 respectively.

With respect to abundance, oak constitutes almost 47 per cent and Douglas fir is second with 42 per cent of the trees over 1 inch DBH. White fir and bigleaf maple follow with about 6 and 4 per cent respectively (table 1). When trees under 1 inch DBH are included, Douglas fir is by far the most abundant with a total of 976 as compared to 505 for oak. Observation

TABLE 1.—Data from sample plots for trees 1 inch DBH and over.

Species	Frequency	Abundance No.	Abundance Per cent	Basal area in sq. ft.	Basal area in per cent	Average per cent of pollen
Pseudotsuga taxifolia	76	378	42.0	156.9	68.2	76.39
Quercus garryana	71	420	45.7	53.9	23.4	4.14
Abies grandis	15	60	6.6	3.0	1.2	2.87
Acer macrophyllum	20	40	4.4	16.7	7.2	0.36
Totals		898	99.8	230.5	100.0	83.76

has shown, however, that little or no pollen is produced by smaller trees, especially those under 3 inches. Douglas fir comprises about 50 per cent of the trees over 3 inches while oak tallies about 42 per cent (table 2). The pollen-percentage average for the ten polsters reveals about 76 per cent for Douglas fir and slightly more than 4 per cent for oak (table 3). Abundance of trees over 3 inches, then, correlated with the average pollen proportions shows that Douglas fir is over-represented by 26 per cent and oak is under-represented by 38 per cent. Of trees over 10 inches, Douglas fir constitutes 80 per cent and oak about 12 per cent (table 2). The latter size-class is more correlative with the pollen averages, with Douglas fir under-represented by 4 per cent and oak by 8 per cent. The basal areas of Douglas fir and oak are somewhat correlative with the pollen statistics. The former constitutes 68 per cent of the total basal area of trees 1 inch and over, while oak composes about 23 per cent (table 1). In this respect, Douglas fir is over-represented by 8 per cent and oak is under-represented by 19 per cent. Data from the sample plots show that lowland white fir is over-represented in basal area and correctly represented by abundance (tables 1, 2). Bigleaf maple, however, is definitely under-represented both from the standpoint of basal area and abundance. This is to be expected because maple is not anemophilous and its pollen is probably sparsely disseminated. The four principal species of the area, then, are represented by pollen-percentage averages in order of their abundance, but white oak and bigleaf maple are under-represented while Douglas fir is slightly over-represented.

The four species discussed above are represented by a total average of about

84 per cent of the pollen in the ten polsters (table 3). Eight other woody species, mostly large shrubs, that occur in the quadrats are not represented by pollen, while at least 9 species, represented by pollen, do not appear in the quadrats. In fact some of them do not occur in the McDonald Forest, except one or two in the arboretum 4 miles away. Of these nine species, red alder is best represented with an average of more than 7 per cent (table 3). Alder is abundant along stream courses and produces a tremendous amount of pollen. Also it is abundant on burns in the main Coast Range a few miles to the west. The next best represented exotic species is western hemlock, with an average pollen percentage of 3.6 (table 3). Although hemlock was not encountered on the sample plots, there are a few specimens in the McDonald Forest and it is abundant on Mary's Peak 10 miles to the southwest. Apparently the prevailing westerly winds were instrumental in disseminating its pollen to the east. Lodgepole pine (*Pinus contorta*) is represented by an average of almost 2 per cent, although it does not occur in the sample plot area, but is present in the arboretum. Pollen identified as pine may include that from many species that are used ornamentally in Corvallis or in the Willamette Valley. Noble fir, another exotic, tallies an average of 1.28 per cent, but apparently the source of its pollen is Mary's Peak, where it is the upper timberline tree. Pollen identified as that from white pine and ponderosa pine (*Pinus ponderosa*) constitutes less than 1 per cent and spruce (*Picea*) tallies .66 percent. The source of this is unknown, but it probably came from ornamentals. The other broadleaf species are represented by a trace, namely Oregon ash and hazel (table 3). The latter may have come from cultivated filberts in the valley and the former from stands of ash along the stream courses.

TABLE 2.—Number of trees in pollen-producing size classes.

Species	3″-10″	10″ and over	Per cent of 3″ and over	Per cent of 10″ and over	Average per cent of pollen
Pseudotsuga taxifolia	154	130	49.4	80.2	76.39
Quercus garryana	220	19	41.6	11.7	4.14
Abies grandis	18	4	3.8	2.4	2.87
Acer macrophyllum	19	9	4.8	5.5	0.36
Totals	411	162		99.8	83.76

The order of abundance and importance of the principal species in the area agrees with the order of their average pollen-percentages. White oak is under-represented to a greater degree than Douglas fir is over-represented. Pollen analysis of three sedimentary columns in the Willamette Valley reveals an influx of oak with pollen proportions as great as 65 per cent in the upper-third of the sections (Hansen, 1942). The chief other species represented during this period is Douglas fir, so it seems probable that oak is under-represented in the sections, and that it was more abundant than the pollen statistics would indicate.

TABLE 3.—Number and per cent of pollen grains obtained from moss polsters.

Species	Douglas fir log		Ground under Douglas fir		On knoll in open		Stump on top of hill		Top of hill		On oak in Douglas fir woods		Top of hill, Douglas fir and maple		Open, south slope		Oak woods		Log in damp ravine		Average
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	
Pseudotsuga taxifolia	166	83	60	60	180	70.6	156	78	90	75	160	80	153	76.5	68	90.6	100	76.9	110	73.3	76.39
Quercus garryana	3	1.5	12	12	19	7.4	8	4	3	2.5	8	4	6	3			4	3.0	6	4.0	4.14
Abies grandis	12	6	4	4	8	3.1	1	0.5	1	0.6	8	4	6	3	2	2.7	3	1.5	5	3.3	2.87
Acer macrophyllum					1	0.4			3	2.5							1	0.7			0.36
Alnus oregona	6	3	10	10	35	13.7	10	5	17	14.1	4	2	13	6.5			13	10	14	9.3	7.36
Tsuga heterophylla	5	2.5	2	2	9	3.5	4	2	3	2.5	12	6	8	4	2	2.7	7	5.3	8	5.6	3.61
Pinus contorta	2	1	4	4	2	0.8	8	4			4	2	6	3	1	1.3	1	0.76	3	2	1.88
Abies procera			2	2			7	3.5	2	1.3	4	2	4	2			1	0.7	2	1.3	1.28
Pinus monticola	2	1	4	4	1	0.4	4	2	1	0.8					1	1.3					0.75
Picea sp.			4	4									4	2					1	0.6	0.66
Pinus ponderosa							2	1							1	1.3	1	0.76			0.4
Fraxinus oregana																			1	0.6	0.06
Corylus spp.	4	2																			0.2
Totals	200		100		255		200		120		200		200		75		130		150		99.96

SUMMARY

A comparison of the composition of a Douglas fir-white oak community with the modern pollen deposition in the area reveals the degree of over-and-under-representation of the anemophilous arborescent species present and the influence of exotic species in distorting the pollen statistics.

On the basis of the number of trees 1 inch and over DBH, Douglas fir constitutes 42 per cent and is recorded by about 76 per cent of the pollen. White oak comprises almost 47 per cent and is represented by slightly more than 4 per cent of the total pollen. Further correlation with abundance shows that trees 10 inches and over are more accurately represented. In this respect, Douglas fir constitutes 80 per cent while oak comprises 12 per cent. On this basis Douglas fir is under-represented by about 4 per cent and oak by about 7 per cent.

When basal area is considered, Douglas fir constitutes 68 per cent and oak 23 per cent, resulting in over-representation of oak by 19 per cent. Lowland white fir with a basal area of 2.4 square feet of trees 10 inches and over and a pollen average of 2.8 per cent is fairly accurately represented. Bigleaf maple is well under-represented on all bases of comparison, probably because it is not wind-pollinated.

Arborescent species not in the area of sampling are represented by an average of about 16 per cent of the total pollen. Among these, the pollen proportions of western hemlock and noble fir reflect the influence of the prevailing westerly winds, carrying their pollen from the Coast Range a few miles to the west. Pollen of other exotic species probably came from ornamental plantings with the exception of red alder which is abundant on floodplains in the area.

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Systematic Studies in the Valerianaceae[1]

Sarah Dyal Nielsen[2]

2732 Regent St., Madison 5, Wisconsin

Plectritis, a genus in the family Valerianaceae, is made up of annual herbs comprising about twenty species native to North America. One species occurs as an adventive in the Chilean Andes of South America.

The genus was proposed by DeCandolle (1830) to include *Valerianella congesta* Lindl. Torrey and Gray (1841) added a second species. Hoeck (1882) later transferred to the genus those species previously assigned to the genus *Betckea.* Gray (1893) concluded that the characters separating *Valerianella* and *Plectritis* were only a matter of degree and accordingly transferred the known species from *Plectritis* to *Valerianella.* Several additional species were described at this time. Suksdorf (1897) again took up the name *Plectritis* to include several of the entities then included under *Valerianella* whereas others were placed in a new genus, *Aligera.*

It is not surprising that the authors of the manuals and floras of western United States experienced difficulty in placing specimens of this genus, with such indecision existing among the various students of the family. Most botanists followed Gray's treatment and included all of the species of this group in *Valerianella.*

This indecision as to the status of the genus prompted the present investigation. The writer became interested in the genus *Plectritis* while revising the genus *Valerianella.* Although these two genera have been confused almost since they were originally separated, there are certain diagnostic characters that readily define them. *Valerianella* typically has a 3-celled ovary, a 3-lobed stigma, and a dichotomously branched inflorescence (Fig. 1). *Plectritis* has a 1-celled ovary, a 2-lobed stigma, and a capitate or interruptedly spicate inflorescence (Figs. 2, 3). The confusion of the two genera in earlier treatments can readily be determined from the descriptions. For example, *Plectritis* is said to be dichotomously branched and to possess a 3-celled ovary. The two wing-like projections on the fruit were considered to be abortive sterile cells.

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1 A portion of a thesis presented to the faculty of the graduate school of Cornell University in partial fulfillment for the degree of Doctor of Philosophy.

2 The writer wishes to acknowledge the help of several persons who have contributed toward the completion of this study. Botanists of western United States aided materially in guiding and accompanying her to fertile and accessible collecting grounds. Curators, custodians and others of this country and Europe have made critical and general collections available. Especially is the writer indebted to the late Dr. K. M. Wiegand who gave so freely of his time, his counsel and experience, and his encouragement during the progress of this study.

EVALUATION OF CHARACTERS IN PLECTRITIS

Plectritis is a perplexing genus. Suksdorf, who studied the genus for about twenty-five years, placed the species considered here in two genera, *Plectritis* and *Aligera*. These were, for the most part, separated as follows:

Plectritis: fruit acutely angled on the convex side of the fertile cell; inrolled margin of the wings connivent at the base only, divergent at the apex; cotyledons accumbent in the seed, dark green with few visible veins when expanded.

Aligera: fruit obtusely angled on the convex side of the fertile cell, usually with a narrow groove down the center; inrolled margin of the wings about equally connivent at both the base and the apex; cotyledons incumbent in the seed, light green with many visible darker green veins when expanded.

The value of these characters becomes doubtful when one critically studies specimens of these genera. The inrolled character of the wings is weakened when the condition in *Plectritis microptera* and *P. aphanoptera,* and the wingless forms of the species is observed. The narrow wings, when present, are about equally connivent at both the base and the apex of the fruit, a feature characterizing *Aligera.* Five of the nine described species of *Plectritis* would be included in this group. In addition certain species of this genus are intermediate in the accumbent to/or incumbent cotyledonary character. Also, the difference in cotyledons, due to coloration and visible venation, disappear when the expanded cotyledons are cleared in alcohol. Thus treated there is little or no difference between the two. There is a tendency, however, for the cotyledons of *Plectritis* to be somewhat thicker than are those of *Aligera. Plectritis magna,* and its variety *nitida,* have obtuse angles on the convex side of the fertile cell of the ovary. Thus, no character employed by Suksdorf for generic separation is entirely diagnostic.

One character, apparently not observed by Suksdorf, that appears to hold for the two genera is the type of hairs at the nodes and on the fruits, when present. Segregates of the genus *Plectritis* have pointed hairs whereas those of *Aligera* are blunt and cylindrical or clavate. That the genus may be divided into two groups as indicated by Suksdorf is true, therefore, but these groups are not of sufficient rank to warrant their treatment as genera. Thus *Aligera* species are here included under *Plectritis.*

Plectritis appears to form a natural group composed of three species series. Former *Aligera* species fall into two groups. The diagnostic characters of these are:

1. Corolla white or tinged with pink, about equally 5-lobed, with a thick spur; hairs on the fruits, when present, without any definite arrangement; inflorescence, when seen from above in the field, cylindrical in appearance due to the greater number of flowers produced on the two arms of the sessile cyme. This "macrocera"3 series includes *P. macrocera* and the varieties *collina, Grayii,* and *mamilata; P. Jepsonii* and *P. Eichleriana.*

2. Corolla pink to deep red, bilabiate with a deeper red dot at the base of the middle lobe of the lower lip, spur slender and often longer than the throat; hairs scat-

3 The designation "congesta," "macrocera," and "ciliosa" are taken from the oldest species in the respective series.

tered on the fruit, and when present, usually with two lateral broad bands on each side of the fertile cell on the convex side of the fruit; inflorescence, when viewed from above in the field, angular or more or less square in outline. This "ciliosa" series includes *P. ciliosa* and the var. *Davyana, P. californica* and the var. *rubens, P. macroptera* and the var. *patelliformis.*

The remaining species that made up Suksdorf's *Plectritis* forms the third group here referred to as the "congesta" series. This includes *P. congesta* and the var. *major, P. magna* and the var. *nitida, P. aphanoptera, P. anomala* and the var. *gibbosa, P. samolifolia* and the var. *involuta.*

Characters used by other workers for differentiating species in this genus are largely those of the flowers and fruits. Typically, the fruit is 1-celled with wing-like projections on the concave side. These wing-like appendages were purported to be the aborted sterile cells, thus giving the basic 3-celled ovary of the *Valerianaceae.* The floral anatomy of the genus shows that this contention cannot be substantiated (unpublished data). On the contrary, these wing-like appendages are outgrowths on the posterior side of the fertile cell and have no relation whatsoever to the sterile cells. Their presence or absence, and the type of cavity formed by these appendages, play an important role in the separation of species.

It is evident in the key to *Plectritis,* that there are several groups of species which differ only in the appearance of the wings and the size of fruit. The smaller fruits seem to be associated in some way with the wingless or narrow-winged fruit forms. In the species attributed to Suksdorf's genus *Aligera,* as the wings become narrower and much thicker the fruit becomes smaller. Examination of numerous individuals of naturally occurring populations of several different species revealed that plants with wings of various widths and others with no wings at all might grow together quite commonly in the same colony. The winged and wingless fruited forms occur abundantly, while the narrow winged forms, when present, are in the minority. These several fruit forms probably indicate only genetic recombinations within a species. Cytogenetic study of members of the genus might help materially in determining the taxonomic value of this character of the *Plectritis* fruit. However, until such a study is completed these fruit forms are here considered as varieties.

Other significant characters that have been used for specific separations include the length of corolla, the width and length of the spur, the presence or absence of the spur, and the presence or absence of nipples on the concave side of the fruit. The length of the corolla and the various features of the spur are relatively constant and have been used freely in former works as well as in the present treatment. The nipples on the other hand are of no taxonomic importance. They are neither constant nor associated with any particular species or group of species. A few fruits with nipples have been observed in species of all three species series. They occur most often, however, in the "ciliosa" series.

The above observations and conclusions, and the following taxonomic treatment of the genus, were based on extensive field study in western United States and principally upon specimens in the following herbaria: Cornell Uni-

versity, Gray of Harvard University, New York Botanical Garden, Missouri Botanical Garden, University of California, State College of Washington, and the United States National. Type specimens were examined in the DeCandolle Herbarium, Geneva, Switzerland, and the Lindley Herbarium, Cambridge, England.

TAXONOMIC TREATMENT

PLECTRITIS DC.

Plectritis DeCandolle, Prodromus 4: 631. 1830.

Annual herbs: stems erect or weak and sprawling: leaves entire or with a few serrations or teeth near the base, short petioled, obovate-oblong; the upper sessile, obolng or linear: bracts linear-subulate, bases of several fused giving a palmate effect: inflorescence capitate or interruptedly spicate: calyx obsolete: corolla 2-8 mm. long, about 5-lobed to strongly bilabiate, funnel-form, usually with a prominent spur at the base of the throat or rarely with the spur reduced to a saccate gibbosity: stamens 3: stigma lobes 2 (rarely 3), flat reniform: ovary 1-celled: fruit a winged or wingless achene, the wings being an outgrowth from the posterior (dorsal) angles of the fertile cell: carina on the anterior angle of the fruit acute, rounded or broad and flat with a narrow goove down the center; cotyledons accumbent[4] or incumbent.[5]

KEY TO THE SPECIES OF PLECTRITIS

A. Fruit carinate, acute or rounded on the convex (anterior) side, never grooved; the infolded wing-like margins of the concave side of the fruit usually connivent at the base and open (diverging) at the apex; cotyledons usually accumbent; hairs on fruit, when present, pointed.

B. Corolla 5-8 mm. long.

C. Fruit winged with a conspicuous concave side ..... 1. *P. congesta.*

C. Fruit wingless, about equally triangular ..... 1a. *P. congesta* var. *major.*

B. Corolla 2-4 mm. long.

D. Fruit obtusely carinate on the convex side and very glossy.

E. The infolded wing-like margins on the concave side of fruit wide, covering about two thirds of that side (dorsal surface of the fertile cell) .... 2. *P. magna.*

E. The infolded wing-like margins of the concave side of fruit narrow, covering less than a third of the concave side ..... 2a. *P. magna* var. *nitida.*

D. Fruit acutely carinate on the convex side and not conspicuously glossy.

F. The infolded wing-like margins of the concave side of fruit narrow, covering about one-half of the concave side ..... 3. *P. aphanoptera.*

F. The infolded wing-like margins of the concave side of the fruit wide and covering more than half of the concave side, or fruits essentially wingless with the margins very narrow and slightly incurved.

G. Spur of corolla reduced to saccate gibbosity at the base of the throat.

H. Fruit large, 3-3.5 mm. wide by 3.5-4 mm. long, winged, with a conspicuous concave side ..... 4. *P. anomala.*

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4 Accumbent—cotyledons lying perpendicular to the ventral surface of the fruit or having edges against the radicle.

5 Incumbent—cotyledons parallel to the ventral surface of the fruit or lying with the back of one against the radicle.

H. Fruit small, 1.5 mm. wide by 2.5 mm. long, wingless, equally triangular .....4a. *P. anomala* var. *gibbosa.*

G. Spur of corolla not reduced.

I. Fruit wingless, triangular .....5. *P. samolifolia.*

I. Fruit winged, with a concave side .....5a. *P. samolifolia* var. *involuta.*

A. Fruit obtusely angled on the convex side with a narrow groove down the center; the wing-like margins on the concave side of fruit about equally connivent at base and apex; cotyledons incumbent; hairs on fruit, when present, clavate or long-cylindrical and blunt.

J. Corolla white or only tinged with pink, weakly bilabiate, or about equally 5-lobed; spur thick.

K. Fruit glabrous or hispid pubescent; hairs, when present, clavate; if glabrous, the wings wide and thin.

L. Wings of fruit wide and spreading, thin; fruit about as long as wide, and 2 mm. or more in width.

M. Wings with a narrow groove on the outer margin; the opening on concave side of fruit wider than long; wings strongly incurved above and below, spreading at center .....6. *P. macrocera.*

M. Wings without groove; the opening on concave side of fruit as long as, or longer, than wide; wings weakly incurved .....6a. *P. macrocera* var. *Grayii.*

L. Wings of fruit narrow and thick, rather strongly incurved; fruits longer than wide, less than 2 mm. wide.

N. Fruit more than twice as long as wide; wings almost abortive .....6b. *P. macrocera* var. *collina.*

N. Fruit hardly twice as long as wide; wings wider, covering two-thirds of the concave side of the fruit .....6c. *P. macrocera* var. *mamillata.*

K. Fruits woolly pubescent or with long cylindrical hairs on the convex side, sometimes only on the fertile cell, if glabrous, wings narrow and thick.

O. Wings thick and narrow; fruit wooly pubescent or glabrous .....7. *P. Jepsonii.*

O. Wings thin and wide, pubescent on the convex side, or glabrous .....8. *P. Eichleriana.*

J. Corolla pink or reddish, strongly bilabiate; spur slender.

P. Wings of fruit thick and short, forming a narrow elliptic opening on the concave side.

Q. Corolla 5-7 mm. long; spur more than 3 mm. long .....9. *P. ciliosa.*

Q. Corolla 2-3 mm. long; spur less than 3 mm. long ....9a. *P. ciliosa* var. *Davyana.*

P. Wings of fruit broad and thin, forming an orbicular or very broad elliptic opening.

R. Wings of fruit strongly incurved, forming an orbicular deep cup-shaped opening on the concave side of fruit.

S. Corolla 5-7 mm. long with a long spur; fruit 3-4 mm. long .....10. *P. californica.*

S. Corolla 2-3 mm. long with a short spur; fruit 2-2.5 mm. long .....10a. *P. californica* var. *rubens.*

R. Wings of fruit spreading, only slightly incurved, forming an elliptic or saucer-shaped opening on the concave side.

T. Corolla 5-7 mm. long with a long spur; fruit 4-4.5 mm. long .....11. *P. macroptera.*

T. Corolla 2-3 mm. long with a short spur; fruit 3-3.5 mm. long .....11a. *P. macroptera* var. *patelliformis.*

1. PLECTRITIS CONGESTA (Lindl.) DC.

Valarianella congesta Lindley, Bot. Reg. 13: 1094. 1827. *Plectritis congesta* (Lindl.) DC., Prodr. 4: 631. 1830. *Plectritis microptera* Suksd., Deut. bot. Monats. 14 (4): 119. 1896. *Plectritis Suksdorfii* Gand., Bull. Soc. Bot. Fr. 18: 35. 1918.

Stems stout, 1.5-4.5 dm. tall, glabrous except for tufts of hairs at the nodes: leaves usually entire, glabrous and obtuse, the lower obovate; the upper obovate to ovate: bracts linear subulate, slightly glandular ciliate: inflorescence capitate: corolla (Fig. 5) 5-8 mm. long, pink or rose, strongly bilabiate, the lip about half as long as the tube, short and thick spur: fruit 2-4 mm. long with wide wings which are connivent at the base and spreading at the apex, pubescent or glabrous, sometimes only ciliate on the margins of the wings; carina on convex side of fruit acute (Figs. 12a, b).

Plants of moist places and along stream banks. Oregon, Washington, British Columbia, Vancouver Island and California.

CALIFORNIA[6]: HUMBOLDT CO., *Eastwood* and *Howell* no. 4833. OREGON: BENTON CO., *Dyal* no. 742; COOS CO., *Smith* no. 3623; DOUGLAS CO., *Cusick* no. 3889; JACKSON CO., *Hammond* no. 187; JOSEPHINE CO., *Dyal* no. 659; KLAMATH CO., *Rose* no. 1074; LANE CO., *Constance, Henderson* and *Rollins* no. 1489; MARION CO., *Hall* no. 236; MULTNOMAH CO., *Henderson* no. 429; POLK CO., *Eastwood* and *Howell* no. 3562; WASHINGTON CO., *Thompson* no. 593. WASHINGTON: CLARKE CO., *Dyal* and *Meyer* no. 670; COWLITZ CO., *Thompson* no. 10113; ISLAND CO., Whidby Is., *Hitchcock* no. 3488; KLICKITAT CO., *Suksdorf* no. 110c; SKAMANIA CO., *Hitchcock* and *Marsh* no. 3333; WHATCOM CO., *Thompson* no. 5914. VANCOUVER ISLAND: *Macoun* no. 88004.

This species was described by Lindley as *Valerianella congesta* from specimens grown under cultivation. Apparently no type was indicated, at least none was found among the specimens examined in the Lindley Herbarium. Seeds of this species were sent to the Horticultural Society of London by Douglas during 1826. Two specimens in the Herbarium at Cambridge University, England, seen by the writer, are labeled "N. Am. *Douglas*." One is typical *P. congesta*, while the other is mixed consisting of one plant of *typical P. congesta* and one of typical *P. anomala*.

P. microptera, a form similar to *P. congesta* but with narrower wings, was described by Suksdorf. He collected specimens of this species growing in colonies of *P. congesta* and its var. *major*. The type specimen of this entity appears to be an intermediate growth form of doubtful specific rank.

P Suksdorfii was based upon specimens sent to Gandoger by Suksdorf. The type specimen is doubtless somewhere in Paris, France. This was not located, however. Sheets bearing the same number and data as the specimen cited by Gandoger are in the herbarium at the Missouri Botanical Garden. Two specimens "Washington ad Bingen, April and May 1885, *Suksdorf* nos. 110 and 2552" may be considered isotypes. These were examined and found to be *P. congesta*. Another specimen cited by Gandoger "Flora of Sequoia Gigantea Region, April 1, 1896, *Geo. Hansen*, no. 1538" has a duplicate

6 Only a limited number of the specimens examined are cited. An effort has been made to cite representative from all counties wherein specimens have been collected.

number in the same herbarium. This was found to consist of young plants of *P. ciliosa*. Other specimens cited by Gandoger that have not been seen include "Idaho, *Heller*" and "Nevada, *Cowgill* and *Kennedy*." The only species known to grow in these localities is *P. macrocera* var. *Grayii*. Thus it appears that Gandoger's concept of *P. Suksdorfii* was based upon a mixture of three distinct species. These facts, and the lack of distinguishing characters for separation, preclude the continued recognition of the species.

1a. PLECTRITIS CONGESTA (Lindl.) DC. var. MAJOR (F. & M.) *Dyal*[7]

Betckea major Fisch. and Mey., ann. Sc. nat. 2nd. ser. Bot. 5: 189. 1836. *Plectritis major* Hoeck, Engl. bot. Jahrb. 3: 37. 1882. *Plectritis racemulosa* Gand., Bull. Soc. Bot. Fr. 18: 35. 1918.

This variety differs from the typical form in having wingless fruits (Figs. 15a, b, c). It was found to have the same distribution as the typical form. Generally most of the colonies contained the species and this variety in about equal numbers. However, one colony found in southern Oregon indicated that pure stands of var. *major* may occur.

OREGON: HOOD RIVER CO., *Suksdorf* no. 2697; JOSEPHINE CO., *Dyal* no. 716a; SISKIYOU CO., *Dyal* no. 716. WASHINGTON: CHEHALIS CO., *A. A.* and *E. G. Heller* no. 4027; KINGS CO., *Frieberg* July 1915; KLICKITAT CO., *Suksdorf* no. 1775; PIERCE CO., *Benson* no. 1448; WHATCOM CO., *Suksdorf* no. 973. BRITISH COLUMBIA: Salt Spring Island, *Macoun* May 11, 1887. VANCOUVER ISLAND: Victoria, *Macoun* no. 416; Cowichan Lake, *Rosendahl* no. 1775.

The type specimen of *P. racemulosa* Gandoger "Whatcom Bay, Washington, July 8, 1890, *Suksdorf* no. 973" is probably somewhere in Paris, France, but it was not located by the writer. A specimen in the Missouri Botanical Garden Herbarium, however, bears the same data as cited in the original description. This is perhaps an isotype. The specimen is an atypical plant of *P. congesta* var. *major*.

2. PLECTRITIS MAGNA (Greene) Suksdorf

Valerianella magna Greene, Proc. Acad. Nat. Sci. Phila. 47: 548. 1895. *Plectritis magna* (Greene) Suksd., Deut. bot. Monats. 15 (5): 145. 1897.

Stems slender, sprawling, 0.5-4 dm. long, glabrous except for tufts of hairs at the nodes: leaves glabrous, diminishing in size upward; the lower obovate-spatulate, obtuse; the upper oblong-ovate to lanceolate, acute: inflorescence capitate or slender and interruptedly spicate; flowers not crowded: corolla (Fig. 7) white or pale pink, 3-4 mm. long, strongly bilabiate, with a short spur at base of throat: fruit pubescent or glabrous, 2-2.5 mm. long, yellowish-brown and very glossy; carina on the convex (ventral) side rounded; wings wide, connivent at base and diverging at apex (Figs. 12 a, b).

Plants of moist places from Santa Clara County to Humboldt and Siskiyou Counties, California; west of the Sierra Nevada Range.

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[7] My maiden name is used in designating new combinations so that there will be continuity between this and earlier work.

CALIFORNIA: GLENN CO., *Heller* no. 1987; HUMBOLDT CO., *Dyal* nos. 715 and 715 c; MARIN CO., *Howell* no. 13798; MENDOCINO CO., *Eastwood* and *Howell* no. 2679; SANTA CLARA CO., *Dyal* and *Nast* no. 718; SAN MATEO CO., *Heller* no. 8466.

The collection from which Greene described this species was made in Knights Valley, California, during 1884. This is now deposited in the Herbarium Greeneanum (University of Notre Dame) where it was examined by the writer. There is no doubt as to the distinctiveness of this species since it is the only known member of the genus that possesses shiny winged fruits with rounded carinae.

2a. PLECTRITIS MAGNA (Greene) Suksd. var. NITIDA (Heller) Dyal

Plectritis nitida Heller, Muhlenbergia 2: 328. 1907.

Differing from the typical form of the species in the wingless fruits which are similar to those figured in 14a and b, but with angle on the ventral side rounded.

The distribution is similar to that of the typical form.

CALIFORNIA: SAN MATEO CO., *Abrams* no. 2457.

The type specimen (*Heller* no. 8578, collected above Crystal Springs on Half Moon Bay road, San Mateo County, May 28, 1907) has not been seen by the writer. One marked "Co-Type" and bearing the same data as that just cited is located in the Missouri Botanical Garden Herbarium. This has been studied by the writer.

3. PLECTRITIS APHANOPTERA (Gray) Suksd.

Valerianella aphanoptera Gray, Proc. Amer. Acad. Sci. 193: 83. 1883. *Plectritis aphanoptera* (Gray) Suksd., Deut. bot. Monats. 15 (5): 144. 1897.

Stems 15-60 cm. tall, glabrous except for tufts of hairs at the nodes: leaves glabrous, not reduced in size toward the inflorescence, obtuse and apiculate, the lower broadly obovate with short petioles, the upper broadly ovate to obovate and sessile: inflorescence capitate; corolla (as Fig. 7) pale pink, 2.5-3.5 mm. long, strongly bilabiate, short spurred; fruit 2-3 mm. long, glabrous or pubescent; wings narrow; carina on convex side of fruit acute (Figs. 13a, b).

The writer collected specimens of this species near the San Francisco Bay region of California, and in southwestern Washington. Additional collecting would probably have shown it to occur in the intervening region also.

CALIFORNIA: LAKE CO., *Eastwood* and *Howell* no. 5768; MARIN CO., *Eastwood* and *Howell* no. 5495; SAN FRANCISCO CO., *Dyal* and *Nast* no. 634; SANTA BARBARA CO., *Suksdorf* no. 184; SANTA CLARA CO., *Heller* no. 8483. OREGON: JOSEPHINE CO., *Piper* June 2, 1921. WASHINGTON: KLICKITAT CO., *Suksdorf* no. 513; LEWIS CO., *Palmer* no. 37940.

A specimen in the Gray Herbarium, examined by the writer, bears two labels, the one "*Valerianella* (*Plectritis*) *aphanoptera* n. sp. Klickitat County, Wash. Terr., *Suksdorf*, 1882, 'Syn. Fl. N. A.'" The second label "Springs on hillsides, Columbia R., W. Klickitat County, Wash. Terr., June 9, 1882, *Suksdorf* (27)". The specimen is doubtless the type. Another specimen,

also examined by the writer, is located at the Missouri Botanical Garden and bears the label "Springy places on rocks, Columbia R., W. Klickitat County, June 9, 1882, *Suksdorf*, no. 15710." This should perhaps be considered as an isotype.

4. PLECTRITIS ANOMALA (Gray) Suksd.

Valerianella anomala Gray, Proc. Amer. Acad. Sci. 19: 83. 1883. *Plectritis anomala* (Gray) Suksd., Deut. bot. Monats. 15 (5): 144. 1897. *Plectritis anomala* (Gray) Suksd. var. *lactiflora* Suksd. Werdenda 1 (4): 43. 1927.

Stem slender or stout, freely branching, glabrous except at the nodes: leaves glabrous, all about equal in size, obtuse to subapiculate; the lower obovate; the upper obovate to ovate: inflorescence capitate: corolla (Fig. 8) white to pale pink, 2-3 mm. long, not strongly bilabiate with a saccate gibbosity at the base of the throat, not spurred: fruit 3-4 mm. long, yellowish-brown, glabrous or pubescent; wings wide and conspicuous, connivent at the base but wide and spreading at the apex; carina on the convex (anterior) side of fruit acute (Figs. 15a, b, c).

In moist places of the San Francisco Bay region of California, and in northwestern Oregon, western Washington and on Vancouver Island.

OREGON: COLUMBIA CO., *Thompson* no. 2463; MULTNOMAH CO., *Henderson* no. 81; WASHINGTON CO., *Henderson* no. 6380f. WASHINGTON: KLICKITAT CO., *Dyal* no. 741a; CHARLES CO., *Lamb* no. 1021. VANCOUVER ISLAND: Somenos, *Macoun* no. 53; Mt. Finlayson, *Macoun* no. 88000.

Following the original description of this species, Gray cited as type material "wet grounds on the Columbia River and near it, *Howell* and *Suksdorf*." Two specimens, examined by the writer, are in the Gray Herbarium. One is labeled "*Valerianella* (*Plectritis*) *anomala* n. sp. Syn. Fl. N. Amer.," Sauves, Isl. Co., Oregon, Apr. 1879, *J. Howell*, no. 216; the other "*Valerianella* (*Plectritis*) *anomala* n. sp., Syn. Fl. N. Am.," Klickitat County, Wash. Terr., 1882, *Suksdorf* (26). This is considered the type collection.

Specimens of this species also labeled "n. sp." are deposited in the herbaria of the New York Botanical Garden and the Missouri Botanical Garden. These bear the following data 'low wet grounds, Columbia River, West Klickitat County, Washington, May, 1882, *Suksdorf*, no. 15709." These are perhaps isotypes.

4a. PLECTRITIS ANOMALA (Gray) Suksd. var. GIBBOSA (Suksd.) Dyal

Plectritis gibbosa Suksd., Werdenda 1 (4): 43. 1927.

This variety differs from the typical form of the species by having wingless fruits (Figs. 14a, b).

CALIFORNIA: SAN MATEO CO., *Eastwood* no. 326. OREGON: DOUGLAS CO., *T. Howell* no. 1166. WASHINGTON: KLICKITAT CO., *Suksdorf* nos. 10866 and 13448; SAN JUAN CO., *S. M.* and *E. B. Zeller* no. 1105. VANCOUVER ISLAND: Alberni, *Carter* no. 309; Victoria, *Macoun* no. 417.

The type specimen, "by a ditch on the meadow, Falcon Valley, east of Laurel, June 27, 1898, 9, 1909, and 18, 1922, Klickitat County, Washington,

Suksdorf, no. 9921," is in the State College of Washington Herbarium. Isotypes seen are in the herbaria of Cornell University and New York Botanical Garden.

5. PLECTRITIS SAMOLIFOLIA (DC.) Hoeck.

Betckea samolifolic DC., Prod. 4: 642. 1830. *Plectritis samolifolia* (DC.) Hoeck., Engler's bot. Jahrb. 3: 37. 1882. *Valerianella samolifolia* (DC.) Gray, Proc. Amer. Acad. 19: 83. 1883.

Stems slender or stout, 15-60 cm. tall, glabrous except at nodes: leaves glabrous, diminishing in size upward; the lower obovate rounded at apex; the upper obovate to oblong or ovate, acute: inflorescence capitate or interruptedly spicate: corolla (Fig. 6) 2-4 mm. long, white to pink, strongly bilabiate with a short spur: fruit 2-3 mm. long, yellowish-brown to brown, glabrous or pubescent, trigonous, wings almost abortive (Figs. 14a, b).

Plants of low moist grounds from the middle coastal region of California to British Columbia and Vancouver Island; also in Chile, S. America.

CHILE: in pascuis saxosis montium prope la Quinta, Quillata, Chile, Sept. 1828, *Bertero* no. 268. CALIFORNIA: HUMBOLDT CO., *Dyal* no. 719; LAKE CO., *Heller* no. 5955; MENDOCINO CO., *Eastwood* and *Howell* no. 4391; MONTEREY CO., *Kellogg*, Apr. 15, 1903; SANTA CLARA CO., *Baker* no. 398. OREGON: DOUGLAS CO., *Cusick* no. 3899. WASHINGTON: ISLAND CO., Whidby Is., *Thompson* no. 6090; KLICKITAT CO., *Dyal* nos. 740 and 741, and *Suksdorf* no. 14011; SAN JUAN CO., San Juan Is., *S. M.* and *E. B. Zeller* no. 1105. VANCOUVER ISLAND: Victoria, *Macoun* nos. 418 and 419.

The type specimen is in the DeCandolle Herbarium at Geneva, Switzerland where it was examined by the writer during 1935. It was collected by Bertero during 1830 "in pascuis montanis prope la Punta de Cortes Chilensium."

5a. PLECTRITIS SAMOLIFOLIA (DC.) Hoeck var. INVOLUTA (Suksd.) Dyal

Plectritis involuta Suksd., Deut. bot. Monats. 15 (5): 144. 1897.

This is a winged form of the typical wingless species. Both have been found repeatedly growing in the same colonies, usually in about the same abundance. They have also been found growing in almost pure colonies. The distributions of the typical species and the variety are very similar (Figs. 6, 15a, b, c).

CALIFORNIA: HUMBOLDT CO., *Dyal* no. 651; MARIN CO., *Dyal, Nast* and *Schreiber* no. 687; MONTEREY CO., *Heller* nos. 6695 and 8919; SAN DIEGO CO., *Spencer* no. 2317; SANTA CLARA CO., *Dyal, Carter, Crum* and *Morrison* no. 685; SHASTA CO., *Eastwood* no. 695; TRINITY CO., *Dyal* no. 751c. OREGON: CURRY CO., *Peck* no. 8561; VAN DOUGAL CO., *Barber* no. 143. WASHINGTON: ISLAND CO., Whidby Is., *Thompson* no. 6090; KLICKITAT CO., *Suksdorf nos.* 13376 and 13379. VANCOUVER ISLAND: Cameron Lake, *Carter*, July 11, 1917; Cowichan Lake, *Rosendahl* no. 1832.

The individuals of this variety are exceedingly variable in appearance. Plants growing in moist shady places inland are tall, often reaching a height of about one meter. Those growing in more exposed sites along the coast are mostly dwarfed whereas others growing in sheltered locations often approach the height and habit of the more inland individuals. Suksdorf included "Kl.

1884" in his original description. This probably refers to his collections made that year which are here considered type material. Two specimens collected during 1884 and named *P. involuta* by Suksdorf have been examined by the writer. One is in the herbarium of the State College of Washington. This was taken "among bushes, damp places, Columbia River, Washington, May 22, 1884, *Suksdorf*, no. 666." The information accompanying the second, which is in the New York Botanical Garden Herbarium, is "wet grounds, Columbia River, West Klickitat County, Washington, May 22, 1884, *Suksdorf*, no. 332." Since both sheets bear essentially the same information, they are doubtless isotypes. The former of these is regarded as the type specimen.

6. PLECTRITIS MACROCERA T. & G.

Plectritis macrocera T. & G., Fl. N. Am. 2: 50. 1841. *Valerianella macrocera* (T. & G.) Gray, Proc. Am. Acad. 19: 83. 1883. *Aligera macrocera* (T. & G.) Suksd., Werdenda 1 (4): 43. 1927.

Stems slender or rather stout, 1-6 dm. tall, glabrous or glandular pubescent in the inflorescence, with tufts of hairs at the nodes: leaves glabrous, diminishing in size upward; the lower obovate and petiolate, obtuse; the upper obovate to ovate or linear, obtuse to subacute, remotely serrate toward the base: bracts glabrous or glandular pubescent: inflorescence capitate or interruptedly spicate, 2-3 verticillate: corolla (Fig. 9) white or tinged with pink, 2-3.5 mm. long, bilabiate or nearly regular with a short thick spur: fruit yellowish, 2-3 mm. long, pubescent or glabrous, the broad wings about equally connivent at base and apex (Figs. 16a, b, c).

Plants of moist or sheltered places from southern California to northern Oregon.

CALIFORNIA: ALAMEDA CO., *Howell* no. 817; CALAVERAS CO., *Dyal* no. 708; GLENN CO., Eastwood no. 11147; KERN CO., *Weston* no. 113; MONTEREY CO., *Dyal* and *Schreiber* no. 705; NAPA CO., *Dyal, Carter* and *Crum* no. 697; SAN BENITO CO., *Eastwood* and *Howell* no. 4261; SANTA CLARA CO., *Eastwood* and *Howell* no. 5327; SISKIYOU CO., *Eastwood* and *Howell* no. 1748; SUTTER CO., *Heller*, no. 11788; TUOLUMNE CO., *Ferris* no. 1660; VENTURA CO., *Eastwood* no. 4992. OREGON: WASCO CO., *Lunell* no. 54. WASHINGTON: Wawawai, *Piper* no. 1505. UTAH: SALT LAKE CO., *Jones* no. 476.

This species was based upon material collected by Douglas in California. Among specimens examined by the writer is one in the Gray Herbarium that is annotated *"Valerianella (Plectritis) macrocera*, California, *Douglas"* Torrey and Gray. Fl. N. Amer.; Syn. Fl. N. Amer. This is considered the type of the species. On the same sheet are mounted specimens of two other collections: one is by Mrs. *A. E. Bush*, Apr. 1880, which is *P. samolifolia*, and the other by *C. L. Anderson*, which is *P. macrocera*.

Jepson (1911) stated in regard to this species that "It is very variable, especially in pubescence of fruit." Gray's (1886) comment also bears quoting "Varies much in length and thickness of spur, also in that of the tubular part of the corolla below the spur, which is sometimes slender and stipe-like, sometimes short."

6a. PLECTRITIS MACROCERA T. & G. var. GRAYII (Suksd.) Dyal

Aligera Grayii Suksd., Deut. bot. Monats. 15(5): 147. 1897.

Differing from the typical form in that the wings are wide and weakly incurved without a groove on the outer margin. The flowers (Fig. 9) tend to be smaller but this character is not constant (Figs. 17a, b, c).

Plants of moist or shady places from western Montana to Idaho, Nevada, California, Oregon and Washington.

UTAH: SALT LAKE CO., Jones no. 6375. NEVADA: ORMSKY CO., *Baker* no. 930. IDAHO: IDAHO CO., *Eastwood* no. 13317; NEZ PERCE CO., *Sandberg* no. 55. MONTANA: SANDERS CO., *Hitchcock* no. 1524. OREGON: HARNEY CO., *Henderson* no. 9237; MALHEUR CO., *Henderson* no. 9239; UNION CO., *Cusick* no. 362; WASCO CO., *Suksdorf* no. 198. WASHINGTON: BENTON CO., *St. John* no. 8064; KITTITAS CO., *Thompson* no. 6217; KLICKITAT CO., *Suksdorf* nos. 23 and 330; SPOKANE CO., *Sandberg* and *Leiberg* no. 60; WHITMAN CO., *Dyal, Packard* and *Meyer* no. 681.

Suksdorf cited specimens from "Wasco County, Oregon, *W. C. Cusick*" and "California, *V. Rattan*" after the original description. The former of these collections has not been seen. The latter is in the Suksdorf collection in the Herbarium of the State College of Washington. It was named by Suksdorf and the identification should be considered authentic.

6b. PLECTRITIS MACROCERA T. & G. var. COLLINA (Heller) Dyal

Plectritis collina Heller, Muhlenbergia 2: 329. 1907. *Aligera collina* (Heller) Suksd., Werdenda 1 (4): 44. 1927.

Differing from the typical form in the smaller, almost wingless fruit, and the upper leaves which are conspicuously serrate (Figs. 18a, b, c).

CALIFORNIA: SANTA CLARA CO., *Dyal, Carter, Crum* and *Morrison* no. 650.

A specimen marked "Co-Type" "Mt. Hamilton, Santa Clara County, California, May 31, 1907, *Heller*, no. 8609" is in the Herbarium of the Missouri Botanical Garden. This has been examined.

This variety is apparently restricted to the Mt. Hamilton Range in California where the type specimen was collected. Specimens were obtained in this region by the writer during 1938. These were taken from a colony wherein *P. macrocera* and its var. *mamillata* were more common.

6c. PLECTRITIS MACROCERA T. & G. var. MAMILLATA (Suksd.) Dyal

Aligera mamillata Suksd., Deut. bot. Monats. 15 (5): 147. 1897. *Aligera ostiolatata* Suksd., *ibid.*

Fruit intermediate between that of the typical form and var. *collina;* wings narrow and thick with a groove on the outer margin (Figs. 19a, b, c).

Growing with the typical form from central California to southern Washington.

CALIFORNIA: ALAMEDA CO., *Michener* and *Bioletti* no. 197; CALAVERAS CO., *Dyal* no. 731; LAKE CO., *Eastwood* and *Howell* no. 5669; MERCED CO., *Eastwood* and *Howell* no. 5323; MONTEREY CO., *Dyal* and *Schreiber* no. 730; SANTA CLARA CO.,

Dyal, Carter and *Morrison* no. 700. WASHINGTON: KLICKITAT CO., *Suksdorf* no. 640, cultivated from seed collected in California by Mrs. K. Curran, White Salmon.

The only information given by Suksdorf with the original description of the species was "Simcoe Mountains, Washington, 1884." A specimen in the Suksdorf collection bears the data "Pitman's Ranch, Simcoe Mountains, Washington, May 6, 1884, *Suksdorf*, nos. 2558-2559." This specimen, and one in the Herbarium of the New York Botanical Garden having the data "dry grounds in open woods, Simcoe Mountains, Klickitat County, May 6, 1884, *Suksdorf*, no. 331," have been studied. Both specimens are probably type material and the former is here considered as the type specimen whereas the latter is an isotype.

Specimens of *Aligera ostiolatata* cited by Suksdorf with the original description include "Antioch in Kal. Mai 1883 (*K. Curran*) and Kal. 1885 (*V. Rattan*)." These are in the Suksdorf collection and were examined at the State College of Washington.

The differences between Suksdorf's *A. mamillata* and *A. ostiolatata* were in variations in pubescence and the presence or absence of dark projections in the cavity formed by the inrolled margins of the wings. A difference in the corollas of these species was also indicated. These characters have been found to be quite variable and of little diagnostic value. The entities are therefore considered as inseparable.

7. PLECTRITIS JEPSONII (Suksd.) Davy

Aligera Jepsonii Suksd., Erythea 6: 24. 1898. *Plectritis glabra* Jepson, Fl. W. Middle Calif. 397. 1911. *Plectritis Jepsonii* Davy, *ibid.*

Stems stout, 1.5-6 dm. tall, glabrous except for tufts of hairs at the nodes: leaves glabrous, diminishing in size toward the inflorescence; the lower obovate with a short petiole; the upper obovate-ovate or oblong, obtuse and remotely toothed at the base: inflorescence capitate or interruptedly spicate, 3-4 verticillate: corolla (Fig. 9) white, 4-5 mm. long, bilabiate, thick spurred: fruit 2-2.3 mm. long, glabrous or woolly pubescent with long cylindrical hairs; wings narrow and thick with a groove along the outer margin, strongly incurved forming a narrow elliptic opening on the concave side of the fruit (Figs. 20a, b, c).

Plants of moist places, usually along stream banks. Apparently restricted to the region north of San Francisco Bay in the Vaca Mountains.

CALIFORNIA: NAPA CO., *Dyal, Carter, Crum* and *Morrison* no. 689; YOLO-COLUSA COS. line, *Dyal, Carter* and *Crum* no. 692; YOLO CO., *Dyal, Carter* and *Crum* no. 694.

The type specimen has not been seen but there is no doubt as to the identity of this species. Dr. Jepson gives a very good illustration of the fruit in his Manual, and the type is presumed by the writer to be in Jepson's personal herbarium.

P. glabra is a glabrous fruited form of *P. Jepsonii*. The writer collected the two forms growing together. No difference other than that of pubescence of the fruits was observed. This appears to have little specific value since

other species of *Plectritis* were observed and reported to have both glabrous and pubescent fruited forms.

8. PLECTRITIS EICHLERIANA (Suksd.) Heller

Aligera Eichleriana Suksd., Deut. bot. Monats. 15 (5): 147. 1897. *Plectritis Eichleriana* (Suksd.) Heller, Muhlenbergia 2: 327. 1907.

Stems stout, 1.5-6 dm. tall, glabrous except for tufts of hairs at the nodes: leaves glabrous, diminishing in size toward the inflorescence; the lower obovate with a short petiole; the upper obovate to ovate or oblong, obtuse to acute and remotely toothed near the base: inflorescence capitate or interruptedly spicate, of 3-4 verticels: corolla white, 4-5 mm. long, bilabiate; spur thick: fruit 2-4 mm. long and about as wide, with thin wide wings: opening on concave side of fruit wider than long; hairs on fruit, when present, long and cylindrical, usually restricted to the fertile cell and the stout apiculation on the convex side; outer margin of wings with a narrow groove (Figs. 21a, b, c).

This species is known only from the Sierra Nevada and Vaca Mountains of California.

CALIFORNIA: COLUSA CO., *Dyal, Carter* and *Crum* no. 698; SACRAMENTO CO., *Heller* no. 12312; YOLO-COLUSA COS. line, *Dyal, Carter* and *Crum* no. 690; YOLO CO., *Dyal, Carter* and *Crum* no. 694a.

Suksdorf, not being familiar with *P. macrocera* T. and G., applied this name erroneously to individuals belonging to the "ciliosa" group. He discovered later that the plants he had included in his *Aligera Eichleriana* more nearly approached the true *Plectritis macrocera* as described by Torrey and Gray. He accordingly reduced his species, *Aligera Eichleriana*, to synonymy under the Torrey and Gray combination.

Specimens labeled *A. Eichleriana* by Suksdorf are not the true *Plectritis macrocera*. The hairs on fruits of Suksdorf's species are long and cylindrical whereas those of *P. macrocera* are short and clavate. Because of this and other diagnostic characters, *P. Eichleriana* is considered a distinct species.

The type is probably "Antioch in California, May, 1883, *K. Curran*." This specimen, which was cited following the original description, is in the Herbarium of the State College of Washington. A second specimen was cited by *Suksdorf*, namely "Kal. *V. Rattan*" but this was not found in the Suksdorf collection.

This species has hairs on the fruit similar to those occurring in *P. Jepsonii*. They are, however, somewhat less abundant. These species are apparently closely related and may represent the winged and wingless fruited forms of a single species. Until they are studied further they may be considered as separate but closely related entities. *P. Eichleriana* has a much wider range than *P. Jepsonii* and, as in the latter, both pubescent and glabrous fruited individuals occur in the same colonies. The glabrous fruited individuals are somewhat less common, however.

9. PLECTRITIS CILIOSA (Greene) Jepson

Valerianella ciliosa Greene, Proc. Acad. Nat. Sci. Phila. 47: 548. 1895. *Aligera ciliosa* (Greene) Suksd., Deut. bot. Monats. 15 (5): 146. 1897. *Plectritis ciliosa* (Greene) Jepson, Man. Fl. Pl. Calif. 970. 1925.

Stem slender, 1-4.5 dm. tall, glabrous except for tufts of hairs at the nodes: leaves narrow, about 3-4 times as long as wide, diminishing in size toward the inflorescence; the lower obovate; the upper oblong, obtuse: bracts glabrous or glandular ciliate: inflorescence capitate or interruptedly spicate: corolla (Fig. 11) 5-7 mm. long, deep pink, bilabiate with a deep red dot at the base on either side of the middle lobe of the lower lip; spur slender, as long or longer than the throat: fruit 2-3 mm. long, pubescent; wings sharply inrolled, narrow and thick, marked lengthwise on the outer margin with a narrow groove; keel on convex side of fruit broad with a groove down the center and a band of stiff hairs on each side; the opening on the concave (posterior) side of fruit narrow-elliptic, hairy with a dark nipple on either side near the middle (Figs. 22a, b, c).

This species is generally distributed throughout the central part of California where it frequents moist or shaded places at the higher altitudes.

CALIFORNIA: CALAVERAS CO., *Dyal* no. 647; ELDORADO CO., *Heller* no. 12290; MADERA CO., *Eastwood* and *Howell* no. 5355; NAPA CO., *Dyal, Carter* and *Crum* no. 640; SANTA CLARA CO., *Heller* no. 8526 and *Dyal, Carter, Crum* and *Morrison* nos. 641 through 645; TUOLUMNE CO., *Dyal* no. 648.

Greene described *Valerianella ciliosa* from material he collected near Oakville, Napa Co., California during 1895. Jepson later made the transfer of this species to the genus *Plectritis*. The description given in his Manual of the Flowering Plants of California is noncommittal as far as the wings of the fruit are concerned but his illustration of the fruit is at variance with the original description by Greene (1895) who stated (p. 548) "The turgid-margined abruptly inflexed wings revealing the ventral cavity by an elliptic acute opening." The wings are not turgid or abruptly inflexed in the illustration by Jepson, nor do they reveal the ventral cavity with an elliptic opening. The fruit illustrated is of the type characteristic of *P. californica*.

9a. PLECTRITIS CILIOSA (Greene) Jepson var. DAVYANA (Jepson) Dyal

Plectritis Davyana Jepson, Fl. West. Middle Calif. 398. 1911.

A small flowered (Fig. 10) variety. Flower 2-3 mm. long with a short spur as opposed to flowers 5-7 mm. long with a long spur in the typical form.

The distribution of the two forms is about the same with that of the variety tending to be somewhat more southern.

CALIFORNIA: ALAMEDA CO., *Howell* no. 1930; FRESNO CO., *Dyal, Carter, Crum,* and *Schreiber* no. 673; KERN CO., *Dyal, Carter, Crum* and *Mathias* no. 676; MARIPOSA CO., *Eastwood* and *Howell* no. 5476; MONTEREY CO., *Dyal, Carter, Crum* and *Schreiber* no. 674; SAN BENITO CO., *Eastwood* and *Howell* no. 5188; SAN LUIS OBISPO CO., *Wiggans* no. 2801; TULARE CO., *Munz* no. 9074.

The type specimen has not been seen. The writer attempted to see Dr. Jepson's specimens during 1938 but, at the time, the herbarium was in the process of being moved and for this reason was unavailable.

10. PLECTRITIS CALIFORNICA (Suksd.) Dyal

Aligera macrocera Suksd. (not T. & G.), Deut. bot. Monats. 15 (5): 147. 1897. *Aligera californica* Suksd., Werdenda 1 (4): 43. 1927.

Stem slender, 1.5-4.5 dm. tall, glabrous except for tufts of hairs at the nodes: leaves entire and glabrous; the lower obovate; the upper oblong and narrow, obtuse; inflorescence capitate or interruptedly spicate: corolla (Fig. 11) 5-7 mm. long, slender, dark pink, bilabiate with a deep red dot at the base on either side of the middle lobe of the lower lip; spur slender, longer than the throat: fruit 3-4 mm. long, pubescent; carina on the convex side broad with a groove down the center and a band of stiff hairs along each side; wings wide, thin and incurved forming an oval opening on the concave (posterior) side (Figs. 24a, b, c).

Plants of moist or shaded places at higher elevations from middle California north to southern Oregon.

CALIFORNIA: BUTTE CO., *Heller* no. 11233; CALAVERAS CO., *Dyal* no. 637; COLUSA CO., *Dyal, Carter* and *Crum* no. 712a; ELDORADO CO., *Eastwood* no. 14164; NAPA CO., *Dyal, Carter, Crum and Morrison* nos. 635 and 682; TEHAMA CO., *Bailey* Apr. 16, 1938.

One of the specimens studied bears "Sweetwater, California, May, 1884, *K. Curran*" and another "Isotype of *A. californica.*" There are two labels on the latter sheet, both bearing the designation *A. macrocera.* One indicated that material had been collected by *Suksdorf* and *K. Curran* during 1883, and the other by *Suksdorf* and *V. Rattan* during 1885. These specimens were mounted after the Suksdorf herbarium was presented to the State College of Washington, but doubtless they are the ones referred to by Suksdorf in his description of *A. californica.* These are considered type material.

The fruits are intermediate between the very wide, thin-winged ones of *P. macroptera* and the narrow thick-winged ones of *P. ciliosa.* They were used by Jepson (1911) and Munz (1935) to illustrate *P. ciliosa.*

10a. PLECTRITIS CALIFORNICA (Suksd.) Dyal var. RUBENS (Suksd.) Dyal

Aligera rubens Suksd., Deut. bot. Monats. 15 (5): 146. 1897. *Aligera barbata* Suksd., Werdenda 1 (4): 43-44. 1927. *Aligera insignis* Suksd., *ibid.*

Corolla 2-3 mm. long (Fig. 10); fruit 2-2.5 mm. long.

This variety has a much wider distribution than the typical form and occurs from southern California to southern Washington.

CALIFORNIA: COLUSA CO., *Dyal, Carter* and *Crum* no. 683; FRESNO CO., *Dyal, Carter, Crum* and *Schreiber* no. 646; LAKE CO., *Jussel* no. 21; MADERA CO., *Eastwood* and *Howell* no. 5399a; MARIN CO., *Eastwood* no. 2507; MONTEREY CO., *Eastwood* no. 4073; NAPA CO., *Dyal, Carter, Crum* and *Morrison* no. 635a; RIVERSIDE CO., *Jones* no. 3167; SAN DIEGO CO., *Spencer* no. 462; SANTA CLARA CO., *Dyal, Carter, Crum* and *Morrison* no. 638. WASHINGTON: KLICKITAT CO., *Suksdorf* nos. 2557, 13473 and 13477.

Suksdorf referred the glabrous fruited form (Fig. 25) of *Plectritis califor-*

nica var. *rubens* to *Aligera rubens*, the form typically with nipples and bands of stiff hairs on each side of the fertile cell (convex side of fruit, Figs. 23a, b, c) to *A. barbata*, and the form without bands of hairs but with scattered hairs and nipples to *A. insignis*. These are considered inseparable and all are here included under this new combination. All occur together commonly and frequently with the typical form. Suksdorf apparently did not observe the red dots on the lower lip of *A. rubens*. All specimens collected by the writer possessed this feature. The presence or absence of the dots on herbarium materials appears to depend largely upon the drying of the specimens.

The type specimens of these three species by Suksdorf here referred to as *Plectritis californica* var. *rubens* were examined in the herbarium of the State College of Washington. The type for *Aligera rubens* was given as "Kl. in 1880 und spater," that of *A. insignis* as "April 1885, *R. C. Orcutt*," and that of *A. barbata* as "south slope of Bingen Mountain near Bingen, Washington, May 1910, *Suksdorf*, no. 7006."

11. PLECTRITIS MACROPTERA (Suksd.) Rydb.

Aligera macroptera Suksd., Deut. bot. Monats. 15 (5): 146. 1897. *Plectritis macroptera* (Suksd.) Rydb., Fl. Rocky Mts. 818. 1917.

Stems slender or relatively stout 1-3.5 dm. tall, branching at nodes of the more robust plants, glabrous except for tufts of hairs at the nodes: leaves entire and glabrous, diminishing in size upward; the lower obovate; the upper oblong to linear-oblong, obtuse: inflorescence capitate or interuptedly spicate: corolla (Fig. 11) 5-8 mm. long, dark pink, bilabiate with darker dots at the base on either side of the middle lobe of the lower lip; spur long and slender: fruit pubescent, 3-4 mm. long and about as wide; wings wide and thin extending beyond the stout apiculation of the fertile cell, weakly inrolled forming a broad opening on the concave side of the fruit; carina on the convex side of fruit broad with a groove down the center and a band of stiff hairs on either side (Figs. 26a, b, c).

Plants of moist or shaded places at the higher elevations from middle California to southern Washington.

CALIFORNIA: CALAVERAS CO., *Dyal* nos. 712 and 714; COLUSA CO., *Dyal, Carter* and *Crum* no. 712; NAPA CO., *Dyal, Carter, Crum* and *Morrison* no. 691; TUOLUMNE CO., *Dyal* no. 713. OREGON: MARION CO., *Henderson* no. 6061. WASHINGTON: KLICKITAT CO., *Suksdorf* nos. 5566, 11851, 13433 and 13475.

Apparently no type specimen exists for this species. Suksdorf cited "Kl. 1878 und spater!, Wasko County, in Oregon" after the original description. These specimens were not found among Suksdorf's types in the herbarium of the State College of Washington. Specimens labeled *Aligera macroptera* by Suksdorf have been studied. These are regarded as typical of the species and, unless the designated type specimen is located elsewhere, these specimens should probably be regarded as type material.

11a. PLECTRITIS MACROPTERA (Suksd.) Rydb. var. PATELLIFORMIS (Suksd.) Dyal

Aligera patelliformis Suksd., West. Amer. Sci. 12 (3): 53. 1901. *Aligera glabrior* Suksd., Werdenda 1(4): 43-44. 1927. *Aligera intermedia* Suksd., *ibid.* *Aligera macroptera* Suksd. var. *obtusa* Suksd., Nomum nudum.

Differing from the typical form in the smaller corolla, 2-3 mm. long with a short spur, and the smaller fruits, 3-3.5 mm. long.

This variety appears to have a somewhat wider distribution than the typical form. It occurs in moist or shaded places at the higher elevations from southern California to southern Washington.

CALIFORNIA: KERN CO., *Dyal, Carter, Crum* and *Mathias* no. 684; MARIPOSA CO., *Howell* no. 334; MONTEREY CO., *Dyal, Carter, Crum* and *Schreiber* no. 680; SAN DIEGO CO., *Dyal* no. 677. WASHINGTON: KLICKITAT CO., *Suksdorf* nos. 6959, 7007, 11844 and 11845.

Three species and a variety described or named by Suksdorf, namely: *Aligera patelliformis, A. intermedia, A. glabrior* and *A. macroptera* var. *obtusa,* are included here under *Plectritis macroptera* var. *patelliformis.* All have small corollas and fruits but the pubescence on the fruits varies considerably. The pubescence of *Aligera intermedia* is similar to that of the typical form. *A. patelliformis* lacks the stiff band of hairs on the convex side of the fruit. *A. glabrior* (Fig. 28) has glabrous fruits. To the writer's knowledge *A. macroptera* var. *obtusa* was never described by Suksdorf. Specimens labeled thus were distributed, however. Variations similar to those found in this group occur in other species of *Plectritis,* as for example *P. congesta* and *P. Jepsonii.* These are not considered as of specific or varietal rank.

The type material of these species is in the herbarium of the State College of Washington. The following information was taken by the writer from the labels of the specimens cited with the original descriptions: *A. patelliformis* "Type, June, 1897, *S. B. Parish,* no. 4539"; *A. intermedia* "Isotype, Am Bingenburge bei Bingen Wash., 16 Mai, 1910, *Suksdorf,* no. 7007," and "isotype of a cotype, 30 April, 6 Mai, 1925, *Suksdorf,* no. 11845"; *A. glabrior* "isotype, an feuchten stellen bei Bingen, Wash., 22 April, 16 Mai, 1910, *Suksdorf,* no. 6959" and "isotype of a cotype, April 5, Mai, 1925, *Suksdorf,* no. 11844." These isotypes should probably be considered the types of his species since no labeled type specimens have been found in the Suksdorf collection or elsewhere. The specimens were mounted after they were donated to the State College of Washington. It is not known if types were designated by Suksdorf and, if so, whether they were separated from the duplicates collected and named by him.

EXCLUDED SPECIES

Plectritis brachystemon F. and M., Ind. Sem. Hort. Petrop. 2 (22) 47. 1835.—The type specimen of this species has not been seen. Gray treats it as a form of *Valerianella congesta* (=*Plectritis congesta*) in the Synoptical Flora. The small flowers referred to in the original description (1894) suggests closer affinity to *P. samolifolia* var. *involuta.*

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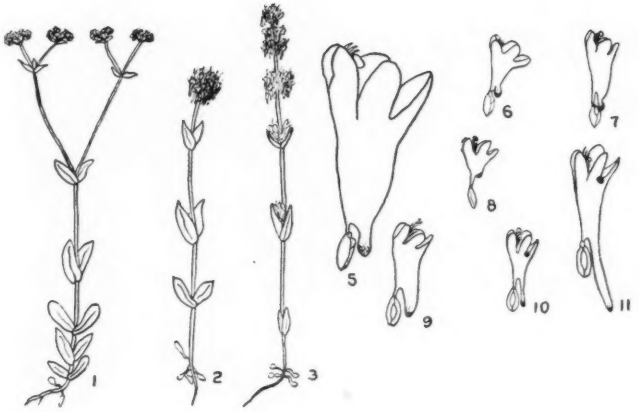
EXPLANATION OF PLATES

Figs. 1-3.—Inflorescence types of *Valerianella* and *Plectritis:* Fig. 1, *Valerianella* showing dichotomous branching. Fig. 2, *Plectritis* showing a capitate inflorescence. Fig. 3, *Plectritis* showing an interruptedly spicate inflorescence. Fig. 4, Map showing distribution of the three species-series of *Plectritis.* Figs. 5-11.—Corolla types of *Plectritis:* Fig. 5, *P. congesta* var. *major.* Fig. 6, *P. samolifolia* var. *involuta.* Fig. 7, *P. aphanoptera, P. magna* and var. *nitida.* Fig. 8, *P. anomala* and var. *gibbosa.* Fig. 9, *P. macrocera*-series. Fig. 10, *P. ciliosa* var. *Davyana, P. californica* var. *rubens* and *P. macroptera* var. *patelliformis.* Fig. 11, *P. ciliosa, P. californica* and *P. macroptera.*

Figs. 12-20.—Fruits of *Plectritis:* Fig. 12, (a) side and (b) cross-section of *P. magna;* Fig. 13, (a) side and (b) cross-section of *P. aphanoptera;* Fig. 14, (a) side and (b) cross- section of *P. samolifolia;* Fig. 15, (a) side, (b) dorsal and (c) cross-section of *P. samolifolia* var. *involuta;* Fig. 16, (a) dorsal, (b) ventral and (c) cross-section of *P. macrocera;* Fig. 17, (a) dorsal, (b) ventral and (c) cross-section of *P. macrocera* var. *Grayii;* Fig. 18, (a) dorsal, (b) ventral and (c) cross-section of *P. macrocera* var. *collina;* Fig. 19, (a) dorsal, (b) ventral and (c) cross-section of *P. macrocera* var. *mamillata;* Fig. 20, (a) dorsal, (b) ventral and (c) cross-section of *P. Jepsonii.*

Figs. 21-27.—Fruits of *Plectritis:* Fig. 21, (a) dorsal, (b) ventral and (c) cross-section of *P. Eichleriana;* Fig. 22, (a) dorsal, (b) ventral and (c) cross-section of *P. ciliosa;* Fig. 23, (a) dorsal, (b) ventral and (c) cross-section of *P. californica* var. *rubens;* Fig. 24, (a) dorsal, (b) ventral and (c) cross-section of *P. californica;* Fig. 25, ventral view of a form of *P. californica* var. *rubens;* Fig. 26, (a) dorsal, (b) ventral and (c) cross-section of *P. mocraptera;* Fig. 27, ventral view of a form of *P. macroptera* var. *patelliformis.* For clarity hairs have been omitted from all cross-sections of fruits.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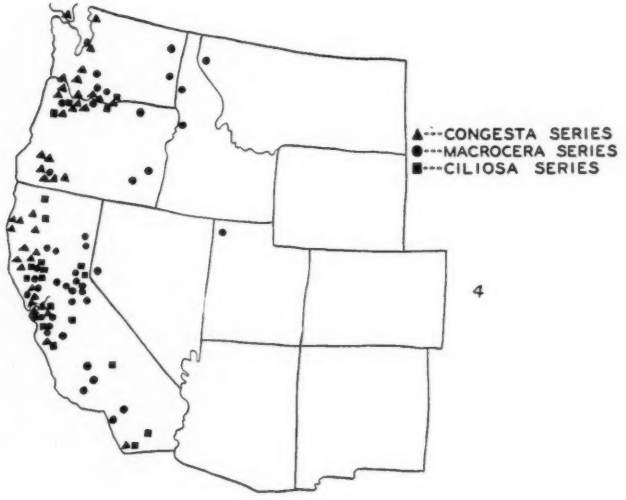
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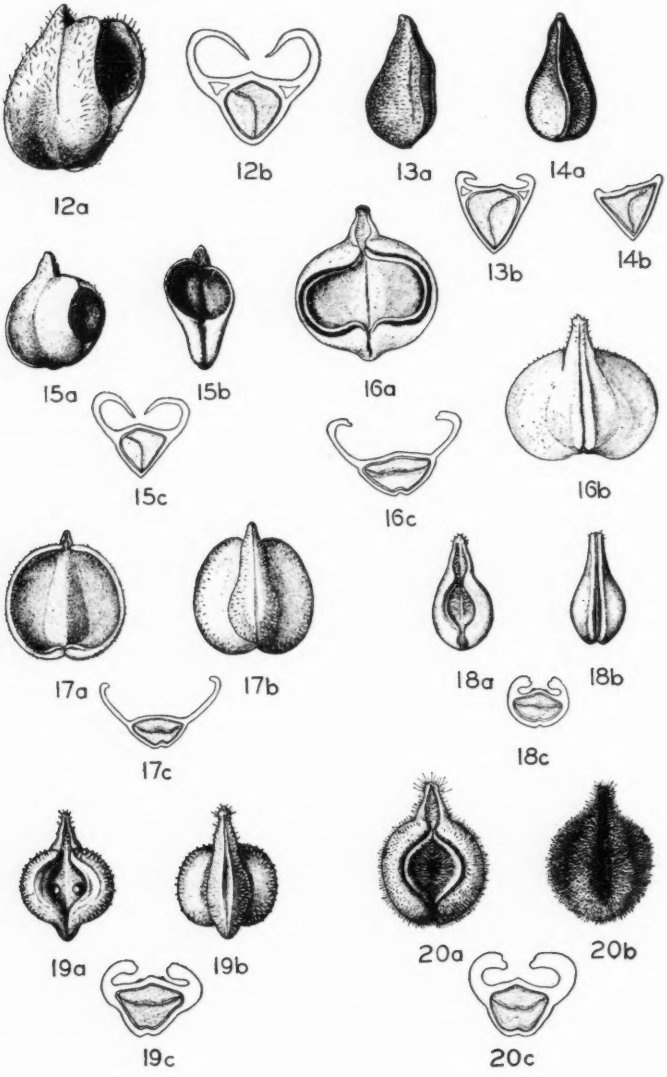
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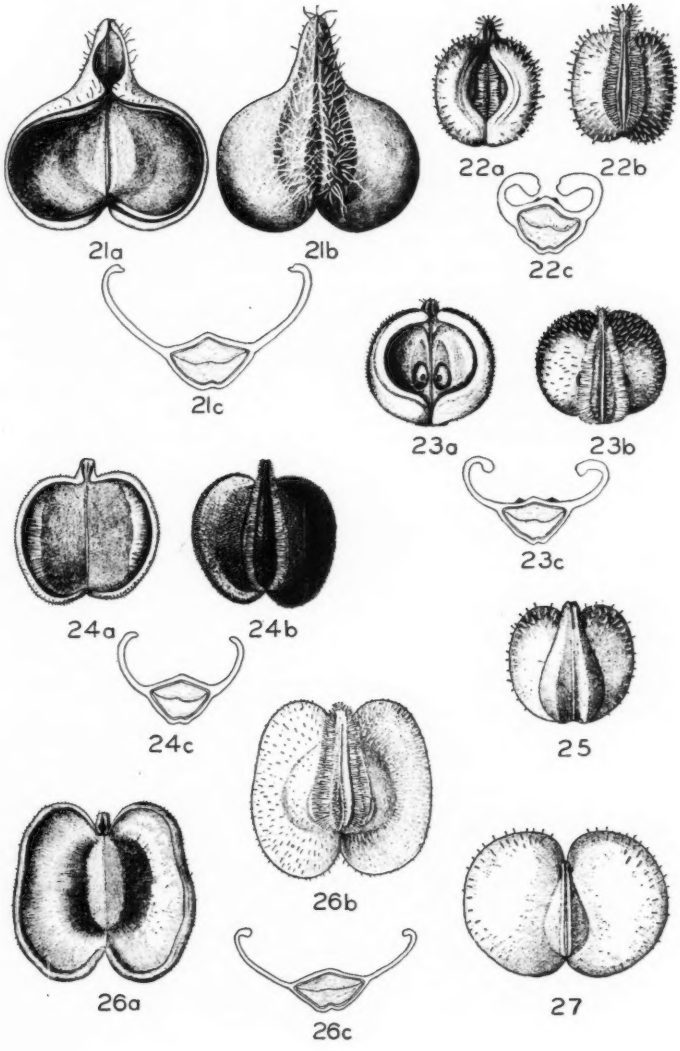
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The Asters of Minnesota: A Floristic Study[1]

C. O. Rosendahl
Department of Botany, University of Minnesota, Minneapolis

Arthur Cronquist
Department of Botany, State College of Washington, Pullman

In this paper we intend to present a companion to our study of the goldenrods of Minnesota (Am. Midl. Nat. 33: 244-253. 1945.). Our work is floristic, not monographic; no new names or combinations are here proposed. The basis for admission of entities into this treatment is the presence of specimens from Minnesota in the herbarium of the University of Minnesota or the New York Botanical Garden. A brief discussion of the phytogeographic regions of the state will be found in our previous paper.

The taxonomic difficulty of the genus *Aster* is so well known that it needs no reiteration here. It now seems established that much of the difficulty is due to natural hybridization, in some cases amplified by recent human disturbance. A disproportionate number of hybrid intermediates have found their way into herbaria, and some of them have been given specific names. No attempt is made to provide for these in the key; some of the more common or better-known ones are discussed in the text.

In spite of the unquestioned difficulties, natural, definable species do exist, and after some practice these can be recognized in the field perhaps even better than in the herbarium. Many of the characters are indefinite, or scarcely tangible, or not wholly constant, so that keys and descriptions must be unusually long and studded with exceptions and qualifications. Particular attention should be paid to obtaining the underground parts for herbarium specimens, since these provide some of the most useful taxonomic characters.

The several small groups which some American botanists have recognized as distinct genera are here retained in *Aster*. The admittedly impressive differences on which some of these are based commonly prove inconstant when a larger number of species is examined, and when the whole genus is considered the characters are found to interlock and intergrade in such a way that no one has yet been able to put forth a system by means of which all the species can be referred either to *Euaster* or to a morphologically definable segregate. Furthermore, although the acceptance of these several segregates would greatly increase the number of genera to be dealt with, the number of species retained in *Aster* proper would still be very large, so that there would be little if any gain in convenience. When it is further understood that, with the possible exception of *Unamia*, these segregates seem in general to be closely related to and derived from *Aster* proper, there remains little point in maintaining the separation.

1 Contribution from the Herbarium of the University of Minnesota XIII.

Although an attempt has been made to juxtapose related species in the key and text, the sequence is not phyletic.

KEY TO THE SPECIES

1 Heads discoid, the pistillate flowers with short tubular corolla exceeded by the pappus; annuals. (*Brachyactis*)

1. Heads radiate; perennials.

2. Pappus double, the inner of long capillary bristles, the outer of short bristles about 1 mm. long or less. (*Doellingeria*)

3. Heads mostly 23-54 flowered, with 7-14 rays and 16-40 disk-flowers; leaves mostly glabrous beneath ..... 2. *A. umbellatus.*

3. Heads mostly 12-22 flowered, with 4-7 rays and 8-15 disk-flowers; leaves puberulent beneath ..... *A. pubentior.*

2. Pappus simple, not divided into distinct inner and outer series.

3. Disk white; some of the pappus-bristles clavate-thickened toward the tip; achenes glabrous. (*Unamia*) ..... 4. *A. ptarmicoides.*

3. Disk purple, red or yellow; none of the pappus-bristles clavate; achenes glabrous or hairy.

4. At least the basal or lower cauline leaves cordate or subcordate, and also evidently petioled.

5. Plants glandular in the inflorescence; involucral bracts relatively broad and firm, the outer commonly 1-2.5 mm. wide and not over 2.5 times as long as wide. (*Biotia*) ..... 5. *A. macrophyllus.*

5. Plants not at all glandular; involucral bracts relatively narrow, the outer not over 1 mm. wide and usually at least 3 times as long as wide. (*Euaster*)

6. Leaves ordinarily entire or subentire, sometimes with undulate to crenate-toothed margins; involucral bracts with short, broad, diamond-shaped tips.

7. Plants with nearly all the leaves below the inflorescence cordate or subcordate; involucral bracts minutely pubescent on the backs; leaves glabrous or scaberulous above ..... 6. *A. Shortii.*

7. Plants with only the lower leaves cordate or sub-cordate; involucral bracts glabrous except for the sometimes ciliolate margins; leaves densely scabrous-hispid or hispidulous above ..... 7. *A. azureus.*

6. Leaves evidently toothed (at least the lower ones); involucral bracts with either short or elongate green tips.

7. Plants with long creeping rhizomes; peduncles and branches of the inflorescence generally sparsely or scarcely bracteate, the peduncles of very unequal length, generally some of them over 1 cm. long; inflorescence relatively few-headed, the heads often less than 50, rarely more than 100; involucral bracts with narrow and elongate green tips ..... 8. *A. ciliolatus.*

7. Plants without long creeping rhizomes; peduncles and branches of the inflorescence ordinarily copiously bracteate, especially when the peduncles approach or exceed 1 cm. in length; inflorescence often

with more than 100 heads; green tips of the involucral bracts either narrow and elongate or short and broad.

8. Involucral bracts obtuse or merely acute, their green tips short and broad, the green usually partly or sometimes wholly replaced or obscured by anthocyanin (visible to the naked eye); leaves usually sharply and deeply toothed, with scarcely or obscurely winged petiole ..... *A. cordifolius.*

8. Involucral bracts strongly acute to acuminate, their green tips more or less elongate and narrow, ordinarily not at all purple to the naked eye; leaves usually shallowly and often rather bluntly toothed, the cauline ones often with strongly winged petiole.

9. Plants relatively strongly hairy, the stem usually uniformly pubescent at least above the middle with short spreading hairs, the leaves scabrous above and uniformly pubescent with short spreading hairs beneath; green tips of the involucral bracts tending to be elongate-rhombic; rays commonly bright blue ..... 10. *A. Drummondii.*

9. Plants relatively weakly hairy or subglabrous, the stem glabrous below the inflorescence or the upper part occasionally villous-puberulent in lines, the leaves glabrous or scabrous above, glabrous or more or less villous-hirsute with relatively long, flattened and multicellular hairs beneath; green tips of the involucral bracts very narrow, linear or nearly so; rays commonly pale, bluish or lilac to white ..... 11. *A. sagittifolius.*

4. None of the leaves at once cordate and evidently petioled. (*Euaster*)

5. Involucre (and often also the whole inflorescence) evidently glandular.

6. Perennial from a stout caudex or short thick rhizome; rays mostly 45-100 ..... 12. *A. novae-angliae.*

6. Perennial from long creeping rhizomes; rays mostly 20-40.

7. Leaves and involucral bracts thin; outer involucral bracts herbaceous to the base; n. Minn. ..... 13. *A. modestus.*

7. Leaves and involucral bracts thick and firm; involucral bracts ordinarily distinctly chartaceous at the base; southern and western Minn. ..... 14. *A. oblongifolius.*

5. Plants not glandular.

6. Leaves (except sometimes the lower) more or less strongly auriculate-clasping.

6a. Plants with stem conspicuously spreading-hairy all around; leaves mostly 10-16 times as long as wide, only slightly clasping, long-hairy beneath, at least along the midrib and toward the base; perennial from creeping rhizomes ..... 16. *A. longulus.*

6a. Plants either less hairy or with more strongly clasping, mostly broader leaves, or both.

7. Involucral bracts, at least the inner ones, long-acuminate to attenuate.

8. Perennial from a short stout (rarely more elongate) rhizome or caudex, occasionally with short stolons as well; stem uniformly hairy at least under the heads, densely spreading-hispid to occasionally glabrous below the inflorescence; leaves of the inflorescence not conspicuously crowded ..... 17. *A. puniceus.*

8. Perennial from long creeping rhizomes; stem and branches pubescent in lines above, glabrous or sparingly hispid below the inflorescence; leaves, at least those of the inflorescence; conspicuously crowded .....18. *A. lucidulus.*

7. Involucral bracts obtuse to merely acute, occasionally acuminate.

8. Perennial from a short stout rhizome or branched caudex, occasionally with short creeping rhizomes as well; involucral bracts appressed, conspicuously imbricate in several series; herbage glabrous, except occasionally for some lines of pubescence in the inflorescence, generally more or less glaucous ....20. *A. laevis.*

8. Perennial from long creeping rhizomes, without any well developed caudex; involucral bracts equal or imbricate, often loose or spreading at the tip; herbage pubescent at least in the inflorescence, not glaucous.

9. Principal leaves mostly 1-5 cm. wide, with ovate or lanceolate serrate acuminate blade abruptly contracted or tapering into a relatively long, generally entire, broadly winged, strongly auriculate-clasping base .....19. *A. prenanthoides.*

9. Principal leaves mostly 1-5 (rarely 9) mm. wide, linear to-lance-linear or oblong-linear, entire or subentire, only slightly auriculate-clasping .....15. *A. junciformis.*

6. Leaves scarcely or not at all auriculate-clasping, though sometimes with broad or slightly sheathing base.

7. Leaves silvery-silky on both sides, entire .....21. *A. sericeus.*

7. Leaves glabrous or hairy, but not at all silvery-silky, sometimes toothed.

8. Involucral bracts, at least the outer, with loose or squarrose minutely spinulose-mucronate tips; leaves entire.

9. Heads numerous, often secund on the branches, small, the involucre mostly 3-5 mm. high, the rays mostly 10-20 .....22. *A. ericoides.*

9. Heads relatively few, solitary or clustered at the ends of the branches, or the stem scarcely branched and the inflorescence subracemiform; involucre mostly 5-7 mm. high, the rays mostly 20-30 .....23. *A. falcatus.*

8. Involucral bracts appressed or a little loose, not spinulose-mucronate; leaves entire or toothed.

9. Stems branched to the middle or below, the slender branches mostly widely divergent to horizontally spreading; cauline leaves elliptic-lanceolate, mostly less than 6 times as long as wide, regularly pinnately veined, with all the veins running to the mid-rib; disk corollas goblet-shaped, their lobes 45-75% of the limb.*

10. Plants with well developed creeping rhizomes; leaves short-pubescent above and soft villous-pubescent beneath over the whole surface; corolla lobes 45-60% of the limb .....24. *A. ontarionis.*

* The disk corollas consist of a slender tube and a more or less enlarged limb. The lobes are part of the limb.

10. Plants without well developed creeping rhizomes; leaves more or less minutely scabrous above and glabrous beneath except along the villous mid-rib; corolla lobes 50-75% of the limb .....25. *A. lateriflorus.*

9. Stems paniculately branched in the upper part, the branches of the dense to loose panicle stiffly ascending to somewhat spreading and arching; cauline leaves lanceolate to linear. 7 to 20 times as long as wide, irregularly and obscurely pinnately veined, with one or more pairs of primary lateral veins running to the base, nearly parallel with and close to the mid vein; disk corollas more nearly tubular, their lobes 17-45% of the limb.

11. Involucral bracts not strongly imbricate, the outer generally at least 2/3 as long as the inner or nearly equalling them.

12. Stems glabrous except in lines decurrent from the leaves; leaves lanceolate to narrowly lanceolate, 8-14 times as long as wide, glabrous beneath; lobes of the disk corollas 25-36% of the limb .....26. *A. coerulescens.*

12. Stems bristly hairy all around nearly or quite to the base; leaves linear-lanceolate to linear, 10-16 times as long as wide, scabrous above, more or less pubescent beneath, especially toward the base and along the mid-rib; lobes of the disk corollas 24-35% of the limb..... .....16. *A. longulus.*

11. Involucral bracts more or less strongly imbricate, the outer seldom as much as 2/3 the length of the inner.

12. Inflorescence mostly short and broad (corymbiform), with relatively few large heads; involucre 5-7 mm. high; leaves linear-lanceolate to linear, 15-20 times as long as wide; rhizome filiform, lobes of disk corollas mostly 17-27% of the limb, slender plants of cold bogs .....15. *A. junciformis.*

12. Inflorescence mostly elongate and ample with numerous heads; involucre 3.5-5.5 mm. high; leaves lanceolate, 7-14 times as long as wide; rhizome often 2 mm. thick; lobes of the disk corollas comprising 30-45% of the limb; stouter plants, not of cold bogs .....27. *A. simplex.*

CATALOGUE AND COMMENTS

1. ASTER BRACHYACTIS Blake, Contr. U. S. Nat. Herb. 25: 564. 1925.

Tripolium angustum Lindl. in Hook. Fl. Bor. Am. 2: 15. 1834. *Aster angustus* T. & G., Fl. N. Am. 2: 162. 1841, not Nees, 1818. *Brachyactis angustus* Britton & Brown, Ill. Fl. 3: 383. 1898.

Waste places, mostly on moderately alkaline lake shores throughout the western parts of the state, infrequent eastward as far as Koochiching, Cass and Wright counties; sparingly introduced from W. Am.

2. ASTER UMBELLATUS Mill. Gard. Dict. Ed. 8, No. 22. 1768.

Doellingeria umbellata Nees, Gen. & Sp. Ast. 178. 1832.

Moist low places. *A. umbellatus* is rare in the state, being represented in the Univ. of Minn. herbarium by a few collections along the eastern border from Houston to Chisago Counties. Within our borders it is largely replaced by the following species.

3. ASTER PUBENTIOR Cronquist, Bull. Torr. Bot. Club 74: 147. 1947.

Aster umbellatus var. *pubens* Gray, Syn. Fl. 12: 197. 1884. *Doellingeria pubens* Rydb. Bull. Torr. Bot. Club 37: 147. 1910.

Moist low places and moist woodlands; common throughout the northern half of the state, especially northeastward in the Lake Superior region.

4. ASTER PTARMICOIDES (Nees) T. & G. Fl. N. Am. 2: 160. 1841.

Chrysopsis alba Nutt. Gen. 2: 152. 1818, not *Aster albus* Willd. 1804. *Doellingeria ptarmicoides* Nees, Gen. & Sp. Ast. 183. 1832. *Unamia alba* Rydb. Bull. Torr. Bot. Club 37: 146. 1910.

Common on the prairies and other open places, including the high, exposed bluffs of the southeastern part of the state and the rocky north shore of Lake Superior from Duluth to Pigeon Point, infrequent in the rest of the coniferous area of the state where it is limited to rocky or gravelly knolls or outwash plains dominated by Jack pine.

A spontaneous garden hybrid between *A. ptarmicoides* and a species of *Solidago* appeared some years ago in Europe, and natural hybridism with *Solidago Riddellii* has been suspected. It seems not unlikely that the true affinities of *A. ptarmicoides* are with *Solidago* rather than with *Aster*.

5. ASTER MACROPHYLLUS L. Sp. pl. Ed. 2. 1232. 1763.

Abundant throughout the wooded areas of the northern half of the state, becoming rare and infrequent southward to the region of the Twin Cities. The species is very variable, and numerous segregates have been proposed as distinct species, but most of them are poorly defined and of doubtful standing. The typical form, characterized by thick rough leaves, stout, smooth or nearly smooth stems and broad, flat-topped inflorescences is mostly limited to the southern part of the range, whereas the variety *velutinus*, with villous pubescent stems and leaves pilose beneath is the prevailing form in the north.

6. ASTER SHORTII Hook. Fl. Bor. Am. 2: 9. 1834.

This handsome, well-marked aster is with us limited to wooded hillsides of southeastern Minnesota. All collections of it in the University Herbarium are from Fillmore and Winona Counties, but it undoubtedly occurs in adjoining Houston County to the east and south.

7. ASTER AZUREUS Lindl. Hook. Comp. Bot. Mag. 1: 98. 1835.

Prairies and dry, open woods, mostly in sandy or rocky soils; common on the exposed bluffs throughout the dissected southeastern part of the state, thence northwestward to the headwaters of the Mississippi River. It occurs

most abundantly on sandy areas of the counties bordering on the Mississippi River from the region of the Twin Cities to Brainerd.

8. ASTER CILIOLATUS Lindl. in Hook. Fl. Bor. Am. 2: 9. 1834.

A. Lindleyanus T. & G. Fl. N. Am. 2: 122. 1841. *A. Lindleyanus* var. *ciliolatus* Gray, Syn. Fl. N. Am. 12: 182. 1884.

Woodlands and clearings. Common throughout the northern half of the state and the most abundant aster in the region north of Lake Superior; infrequent southward to Chisago, Kandyohi and Hennepin Counties and with an isolated occurrence in Fillmore County. (In a grove of Balsam Fir near Wykoff.)

9. ASTER CORDIFOLIUS L. Sp. Pl. 875. 1753.

Woodlands; confined to the hardwood region of the southeastern part of the state, occurring from Houston and Fillmore counties northward along the eastern border to the region of the Kettle River in Pine County. Many of our plants are quite typical in having obtuse or merely acute involucral bracts with short and broad green tips. However, there are some in which the phyllaries are acuminate with more elongated green tips, in which respect they approach those of *A. sagittifolius*. These plants may perhaps be referable to *A. cordifolius* var. *moratus* Shinners (originally *A. Finkii* var. *moratus* Shinners. Am. Midl. Nat. 26: 407. 1941.) but within our range the two forms occur intermixed and both have the coarsely serrate, ovate-cordate leaves of the typical species, not like the more elongated ones found in the specimens cited by Shinners for his variety. Whether these are of hybrid origin or whether they constitute a true variety remains to be determined.

10. ASTER DRUMMONDI Lindl. Hook. Comp. Bot. Mag. 1: 97. 1835.

A. sagittifolius var. *Drummondii* Shinners, Am. Midl. Nat. 26: 406. 1941.

Of relatively infrequent occurrence in the hardwoods of the southeastern parts of the state from Houston and Fillmore Counties to Goodhue and southern Rice counties. The plant is characterized by densely pubescent, purplish stems, thick firm leaves and numerous leafy bracts in the inflorescence. *Aster Drummondii* intergrades completely with *A. sagittifolius*, but field studies by Edgar Anderson show that at least in Missouri the currently extensive hybridization is largely a result of recent human disturbance. Phyletically, *A. Drummondii* is almost certainly more closely related to *A. texanus* Burgess, and probably also to *A. undulatus* L., than to *A. sagittifolius*. Occasionally plants of *A. Drummondii*, such as a Holzinger specimen from near Winona, have the petioles slightly auriculate-clasping, thus approaching the more eastern *A. undulatus*. Specimens of this nature have presumably been largely responsible for repeated reports of *A. undulatus* from various midwestern states. It is not known by us to extend farther west than central Ohio, southeastern Indiana, eastern Tennessee, and eastern Mississippi.

11. ASTER SAGITTIFOLIUS Willd. Sp. Pl. 3: 2035. 1804.

Streambanks, woodlands, and less often in open places. Common through-

out the southern part of the state; progressively less frequent from the region of the Twin Cities north to Cass and Otter Tail Counties. The ray flowers are mostly white to pale blue, the disk flowers purplish; the lower and middle phyllaries have sharp, firm tips.

12. ASTER NOVAE-ANGLIAE L. Sp. Pl. 875. 1753.

In moist, chiefly calcareous ground, open or sometimes wooded places, often along roadside ditches and fence rows; fairly common throughout the southern half of the state and along the western part northward to Marshall and Roseau counties, absent from the northeastern coniferous area. The most handsome and showy of our native asters. Forma *roseus* with pink or rose-colored ray flowers occurs occasionally throughout the range of the species. A hybrid with *A. ericoides* has been named *A. amethystinus* Nutt.

13. ASTER MODESTUS Lindl. in Hook. Fl. Bor. Am. 8. 1834.

Moist, open or wooded places. The species is known only from a few stations in St. Louis and Lake counties. It is a far western plant and its occurrence in the Lake Superior region is an example of disjunct distribution, of which there are a number of similar cases in the same general area involving other genera.

14. ASTER OBLONGIFOLIUS Nutt. Gen. 2: 156. 1818.

A. oblongifolius var. *rigidulus* Gray, Syn. Fl. N. Am. 12: 179. 1884.

Dry, usually open places. Common on south- and west-facing bluffs of the southeastern part of the state as far north as Washington County and locally westward on hills and glacial knolls throughout the Minnesota River Valley; more frequent toward the western border from Rock County northward to Otter Tail County. Dr. Shinners has described as var. *angustatus* a narrow-leaved form in which the leaves, measuring 3.5-6 cm. long, are said to be 7 or more times as long as wide (Am. Midl. Nat. 26: 418. 1941.). It is stated to occur on dry prairies of southwestern Wisconsin as far north as La-Crosse County. It may, therefore, reasonably be expected to be found in similar situations in the adjoining parts of Minnesota. In discussing the status of *A. oblongifolius* (l. c.) he has pointed out that the type belongs to the phase that has commonly been treated as var. *rigidulus*.

15. A. JUNCIFORMIS Rydb. Bull. Torr. Bot. Club 37: 142. 1910.

A. junceus Am. Auth., probably not Ait.

Common in peaty meadows, sedge mats and spruce-tamarack bogs of the northern half of the state, infrequent southward through Dakota, Goodhue and Wabasha to Winona counties.

16. ASTER LONGULUS Sheldon, Minn. Bot. Stud. 1: 18. 1894.

In moist habitats, mostly in meadows and along lake shores. Occurs mainly from Chisago and Mille Lacs counties northward and eastward to the Lake

Superior region where it is fairly common from Duluth to Grand Marais. Dr. Shinners (Rhodora 44: 338. 1942.) regards *A. longulus* as a hybrid between *A. junciformis* and *A. puniceus,* and in support of his interpretation lists a number of characters in which he finds that it occupies an intermediate position between the two assumed parents. While this may be true for the characters selected, it is by no means so for others which are probably fully as important. *A. longulus* has uniformly smaller heads than either of the supposed parents. The inflorescence is paniculiform with numerous heads, instead of relatively few. The lobes of the disk corollas of *A. longulus* constitute 24-35% of the limb, whereas in *A. junciformis* the length of the lobes varies from 17-27% and in *A. puniceus* 17-24%. When the measurements are averaged, the figures for the three species are respectively 30, 21.6 and 21 per cent. According to Shinner's own statement the time of flowering of the putative parents is not the same for he says: ". . . the type specimen of *A. longulus* was coming into flower in July, the usual time for *A. junciformis,* but a month or more too early for *A. paniculatus,* or *A. puniceus* in most years." It may also be significant that the pollen from the type of *A. longulus* is practically 100% good and the same is true for a number of recent collections referable to the same entity. In the various places where we have observed the plant in the field it occurs in considerable numbers and there is every indication that the species exists as a natural population. Until more convincing proof of the hybrid nature of *A. longulus* is produced, it seems better to retain its specific status.

17. ASTER PUNICEUS L. Sp. Pl. 875. 1753.

Swamps and other moist places, in shade or sun; the species occurs most frequently in spruce-tamarack bogs throughout the northern half of the state; infrequent in moist situations along the eastern border south to Goodhue County. Plants with the stem nearly glabrous below the inflorescence may be distinguished as var. *firmus* (Nees) T. & G. (*A. puniceus* var. *laevicaulis* Gray, Syn. Fl. 1^2: 195. 1884.).

18. ASTER LUCIDULUS (Gray) Wieg. Rhodora 26: 4. 1924.

A. puniceus var. *lucidulus* Gray, Syn. Fl. N. Am. 1^2: 195. 1884.

Moist places; fairly common on bottomlands in the southeastern part of the state as far north as Dakota, Scott and Hennepin counties; infrequent or rare northwestward as far as the region of Itasca Park. In the bottomlands of the Minnesota River southwest of the Twin Cities the species occurs abundantly but in this locality there is a tendency toward a more open panicle and for the upper cauline leaves to be less crowded. These forms suggest possibly some admixture of *A. simplex,* which is common in the area.

19. ASTER PRENANTHOIDES Muhl. ex Willd. Sp. Pl. 3: 2046. 1804.

A. oticus Rydb. Brittonia 1: 103. 1931.

Stream banks, meadows, and moist woodlands; fairly common in the southeastern part of the state from Houston and Fillmore counties northward to

Goodhue County. The species is readily distinguished by its sharply toothed leaves, the blades of which are long acuminate at the apex and abruptly narrowed at the base into an entire, broadly winged petiole with a conspicuously auricled base. Rydberg's *A. oticus* is scarcely more than a form of *A. prenanthoides* in which the leaves consist mainly of the dilated petiolar portion without the expanded sharply-toothed blade.

20. ASTER LAEVIS L. Sp. Pl. 876. 1753.

Aster laevis var. *amplifolius* Porter, Mem. Torr. Bot. Club 5: 324. 1894.

Open usually dry places, common throughout the southern and western parts of the state as far north as the southern tip of St. Louis County in the east and Kittson County in the northwest. In the north it becomes gradually less frequent eastward as far as Itasca County and appears to be absent from most of St. Louis and all of Lake and Cook counties. The common form of *A. laevis* has phyllaries with short, rhombic green tips while the variety *Geyeri* Gray, which enters our range from the west, has fewer-seriate, narrower, more sharply pointed phyllaries with more elongated green tips (*A. geyeri* Rydb.). A number of the collections from the northwestern part of the state belong to this variety.

21. ASTER SERICEUS Vent. Hort. Cels. Pl. 33. 1800.

Dry prairies, and other open places. Common on the exposed south and west facing bluffs of the southeastern part of the state as far north as Washington County, thence westward and northward throughout the prairie country to the northwest corner. Absent from the coniferous area of the northeast.

22. ASTER ERICOIDES L. Sp. Pl. 875. 1753.

A. multiflorus Ait. Hort. Kew. 3: 203. 1789.

Dry, open places; common in most parts of the state except northeastward where it occurs infrequently in the Duluth region. There are no collections in the University Herbarium from the area north of Lake Superior. True *A. ericoides* has the pubescence of the stem mostly appressed or closely ascending. The less common variety, *prostratus* (Kuntze) Blake (Rhodora 32: 138. 1930.), has the pubescence of the stem and branches spreading to deflexed (*A. exiguus* Rydb. Bull. Torr. Bot. Club 33: 153. 1906.). The species is very variable and a number of poorly defined segregates have been proposed.

23. ASTER FALCATUS Lindl. in DC. Prodr. 5: 241. 1836.

A. ramulosus var. *incanopilosus* Lindl. in DC. Prodr. 5. 243. 1836. *A. multiflorus* var. *commutatus* T. & G. Fl. N. Am. 2: 125. 1841. *A. commutatus* Gray, Syn. Fl. 12: 185. 1884. *A. incanopilosus* Sheld. Bull. Torr. Bot. Club 20: 286. 1893.

Prairies and other open places. The species resembles *A. ericoides* but is distinguished by fewer, larger heads with more numerous rays. It is limited to the prairie country in the western part of the state and is there chiefly represented by the variety *crassulus* (Rydb.) Cronq. which is characterized by

the stems being hispid or hirsutulous with spreading or reflexed hairs instead of merely strigose.

24. ASTER ONTARIONIS Wieg. Rhodora 30: 179. 1928.

A. missouriensis Britton in Britton & Brown Ill. Fl. 3: 378. 1898, not *A. missouriensis Kuntze*, (Nutt.) 1891. *A. pantotrichus* Blake, Journ. Wash. Acad. Sci. 21: 327. 1931.

Common in woods, thickets and on river bottoms of the southern part of the state as far north as Chisago County in the east, less frequent northwestward as far as Otter Tail County. The species is readily distinguished from the following by the soft velvety pubescence of the underside of the leaves.

25. ASTER LATERIFLORUS (L.) Britton, Trans. N. L. Acad. Sci. 9: 10. 1889.

Solidago lateriflora L. Sp. Pl. 879. 1753. *Aster hirsuticaulis* Lindl. in DC. Prodr. 5: 242. 1836.

Open woodlands and dry open places. True *A. lateriflorus* is rather scarce in Minnesota and appears to be mainly limited to the northeastern part of the state. The more common form is the variety *pendulus* (Ait.) Burgess with nearly horizontal spreading to slightly recurved slender branches which are beset with numerous elliptic, distinctly smaller leaves than those of the main stem. It is distributed over most of the state but occurs chiefly in hardwood forests and thickets.

26. ASTER COERULESCENS DC. Prodr. 5: 235. 1836.

A salicifolius var. *caerulescens* Gray. Syn. Fl. 12: 188. 1884. *A. hesperius* Gray, Syn. Fl. 12: 192. 1884.

The species is fairly common in moist open places, chiefly in the northern half of the state, less frequent southeastward to Scott and Goodhue counties. It has recently been claimed that the original of *A. coerulescens* is merely a form of *A. praealtus* Poir. If that claim is verified, then the present species will take the name *A. hesperius* Gray. In Minnesota *A. coerulescens* (or *A. hesperius*) hybridizes freely with *A. simplex*, and the distinction sometimes becomes entirely arbitrary.

27. ASTER SIMPLEX Willd. Enum. Hort. Berol. 887. 1809.

A. paniculatus Lam. Encycl. 1: 306. 1783, not Mill. 1768.

Occurs in low moist places throughout the entire state and is probably the most common and widely distributed of the native asters. It grows in a variety of situations but is most abundant in moist peaty meadows and along roadside and drainage ditches. It is distinguished from the preceding species by the more imbricated involucre and the broader and more noticeably serrate leaves. The typical variety has the leaves mostly 1-3.5 cm. wide and seldom over 11 times as long as wide. Var. *ramosissimus* (T. & G.) Cronq. has the leaves mostly 3-12 mm. wide, and mostly at least 12 times as long as wide.